ROYAL COMMISSION
ON
AGRICULTURE IN INDIA.

Volume I
Part II

EVIDENCE
OF
Officers serving under the Government of India

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ALCUTTA: GOVERNMENT OF INDIA
CENTRAL PUBLICATION BRANCH
1927

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INTERIM REPORT

To

THE KING'S MOST EXCELLENT MAJESTY.

May It Please Your Majesty,

We, the Commissioners appointed to examine and report on the present conditions of agricultural and rural economy in British India, and to make recommendations for the improvement of agriculture and to promote the welfare and prosperity of the rural population; in particular to investigate:—(*a*) the measures now being taken for the promotion of agricultural and veterinary research experiment, demonstration and education, for the compilation of agricultural statistics, for the introduction of new and better crops and for improvement in agricultural practice, dairy farming and the breeding of stock; (*b*) the existing methods of transport and marketing of agricultural produce and stock; (*c*) the methods by which agricultural operations are financed and credit afforded to agriculturists; (*d*) the main factors affecting rural prosperity and the welfare of the agricultural population; and to make recommendations; availing ourselves of Your Majesty's permission to report our proceedings from time to time, desire to submit to Your Majesty certain additional minutes of the evidence which we have taken on the subject of our Inquiry.

All of which we most humbly submit for Your Majesty's most gracious consideration.

(Signed) LINLITHGOW,
Chairman.
(„) H. S. LAWRENCE.
(„) T. H. MIDDLETON.
(„) J. MACKENNA.
(„) H. CALVERT.
(„) N. GANGULEE.
(„) L. K. HYDER.
(„) B. S. KAMAT.

(Signed) J. A. MADAN,
(„) F. W. H. SMITH,
Joint Secretaries.

25th May 1927.

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TERMS OF REFERENCE

Generally,

To examine and report on the present conditions of agriculture and rural economy in British India and to make recommendations for the improvement of agriculture and the promotion of the welfare and prosperity of the rural population;

In particular to investigate—

(*a*) the measures now being taken for the promotion of agricultural and veterinary research, experiment, demonstration and education, for the compilation of agricultural statistics, for the introduction of new and better crops and for improvement in agricultural practice, dairy farming and the breeding of stock;

(*b*) the existing methods of transport and marketing of agricultural produce and stock;

(*c*) the methods by which agricultural operations are financed and credit afforded to agriculturists;

(*d*) the main factors affecting rural prosperity and the welfare of the agricultural population;

and to make recommendations.

It will not be within the scope of the Commission's duties to make recommendations regarding the existing system of landownership and tenancy or of the assessment of land revenue and irrigation charges, or the existing division of functions between the Government of India and the local Governments. But the Commission shall be at liberty to suggest means whereby the activities of the Governments in India may best be co-ordinated and to indicate directions in which the Government of India may usefully supplement the activities of local Governments.

QUESTIONNAIRE

PART I

Question.

1. Research.
2. Agricultural education.
3. Demonstration and propaganda.
4. Administration.
5. Finance.
6. Agricultural indebtedness.
7. Fragmentation of holdings.

PART II

8. Irrigation.
9. Soils.
10. Fertilisers.
11. Crops.
12. Cultivation.
13. Crop protection.
14. Implements.

PART III

15. Veterinary.
16. Animal husbandry.

PART IV

17. Agricultural industries.
18. Agricultural labour.
19. Forests.
20. Marketing.
21. Tariffs and sea freights.
22. Co-operation.
23. General education.
24. Attracting capital.
25. Welfare of rural population.
26. Statistics.

QUESTIONNAIRE

PART I

1. Research.

(*a*) Have you suggestions to advance for the better organisation, administration and financing of—

- (*i*) All research affecting the welfare of the agriculturist, including research into the scientific value of the indigenous theory and traditional methods of agriculture,
- (*ii*) Veterinary research ?.

(*b*) If in cases known to you progress is not being made because of the want of skilled workers, or field or laboratory facilities for study or by reason of any other handicaps, please give particulars. [Suggestions of a general kind should be made under (*a*) ; answers under this heading should relate to specific subjects. The purpose is to secure a list of the problems met with by scientific investigators in the course of their work which are being held over because of lack of resources or deficient organisation.]

(*c*) Can you suggest any particular subject for research not at present being investigated to which attention might usefully be turned ?

2. Agricultural Education.

With reference to any form of agricultural education of which you may have experience, please state your views on the following :—

- (*i*) Is the supply of teachers and institutions sufficient ?
- (*ii*) Is there an urgent need for extension of teaching facilities in any district or districts known to you personally ?
- (*iii*) Should teachers in rural areas be drawn from the agricultural classes ?
- (*iv*) Are the attendances at existing institutions as numerous as you would expect in present circumstances ; if not, state reasons. Can you suggest measures likely to stimulate the demand for instruction ?
- (*v*) What are the main incentives which induce lads to study agriculture ?
- (*vi*) Are pupils mainly drawn from the agricultural classes ?
- (*vii*) Are there any modifications in existing courses of study which appear to be called for ; if so, what are they ?
- (*viii*) What are your views upon (*a*) nature study ; (*b*) school plots ; (*c*) school farms ?
- (*ix*) What are the careers of the majority of students who have studied agriculture ?
- (*x*) How can agriculture be made attractive to middle class youths ?
- (*xi*) Are there recent movements for improving the technical knowledge of students who have studied agriculture ?

(*xii*) How can adult education in rural tracts be popularised ?
(*xiii*) In suggesting any scheme for better educational facilities in rural areas, please give your views for (*a*) its administration and (*b*) its finance.

3. Demonstration and Propaganda.

(*a*) What are the measures which in your view have been successful in influencing and improving the practice of cultivators ?

(*b*) Can you make suggestions for increasing the effectiveness of field demonstrations ?

(*c*) Can you suggest methods whereby cultivators may be induced to adopt expert advice ?

(*d*) If you are aware of any striking instances of the success or the failure of demonstration and propaganda work, please give particulars and indicate the reasons for success or for failure.

4. Administration.

(*a*) Do you wish to suggest means towards the better co-ordination of the activities of the Governments in India or to indicate directions in which the Government of India may usefully supplement the activities of the local Governments ?

(*b*) Is it your opinion that the expert scientific knowledge required in the development of agriculture in the different Provinces could be supplied to a greater extent than is the case at present by increasing the scientific staff of the Government of India ? If so, indicate the types of work which would benefit by pooling the services of experts, and suggest how that work should be controlled.

(*c*) Are you satisfied from the agricultural standpoint with the services afforded by—

(*i*) The Agricultural and Veterinary Services,
(*ii*) Railways and steamers,
(*iii*) Roads,
(*iv*) Meteorological Department,
(*v*) Posts, and
(*vi*) Telegraphs, including wireless ?

If not, please indicate directions in which you think these Services might be improved or extended.

5. Finance.

(*a*) What are your views as to the steps that should be taken for the better financing of agricultural operations and for the provision of short and long-term credit to cultivators ?

(*b*) Do you wish to suggest means whereby cultivators may be induced to make fuller use of the Government system of *taccavi* ?

6. Agricultural Indebtedness.

(*a*) What in your opinion are :—

(*i*) the main causes of borrowing,
(*ii*) the sources of credit, and
(*iii*) the reasons preventing repayment.

(*b*) What measures in your opinion are necessary for lightening agriculture's burden of debt ? For example, should special measures be taken to deal with rural insolvency, to enforce the application of the Usurious Loans Act, or to facilitate the redemption of mortgages ?

(*c*) Should measures be taken to restrict or control the credit of cultivators such as limiting the right of mortgage and sale ? Should non-terminable mortgages be prohibited ?

7. Fragmentation of Holdings.

(*a*) Do you wish to suggest means for reducing the loss in agricultural efficiency attendant upon the excessive subdivision of holdings ?

(*b*) What are the obstacles in the way of consolidation and how can they be overcome ?

(*c*) Do you consider legislation to be necessary to deal with minors, widows with life interest, persons legally incapable, alienation and dissentients, and to keep disputes out of the courts ?

PART II

8. Irrigation.

(*a*) Name any district or districts in which you advocate the adoption of new irrigation schemes, or suggest extensions or improvements in the existing systems or methods of irrigation by—

(*i*) Perennial and non-perennial canals,
(*ii*) Tanks and ponds,
(*iii*) Wells.

What are the obstacles in your district or Province to the extension of irrigation by each of the above methods ?

(*b*) Are you satisfied with the existing methods of distributing canal water to cultivators ? Describe the methods that have been employed to prevent wastage of water by evaporation and by absorption in the soil. What form of outlet for distribution to cultivators at the tail end do you regard as the most equitable and economical ? Have these methods and devices been successful, or do you wish to suggest improvements ?

(*N.B.*—Irrigation charges are *not* within the terms of reference of the Commission, and should not be commented upon.)

9. Soils.

(*a*) Have you suggestions to make—

(*i*) for the improvement of soils, whether by drainage or other means, not dealt with under other headings in this questionnaire.
(*ii*) for the reclamation of Alkali (Usar) or other uncultivable land,
(*iii*) for the prevention of the erosion of the surface soil by flood water ?

(*b*) Can you give instances of soils known to you which, within your recollection, have—

(*i*) undergone marked improvement,
(*ii*) suffered marked deterioration ?

If so, please give full particulars.

(*c*) What measures should Government take to encourage the reclamation of areas of cultivable land which have gone out of cultivation ?

10. Fertilisers.

(*a*) In your opinion, could greater use be profitably made of natural manures or artificial fertilisers ? If so, please indicate the directions in which you think improvement possible.

(*b*) Can you suggest measures to prevent the fraudulent adulteration of fertilisers ?

(*c*) What methods would you employ to popularise new and improved fertilisers ?

(*d*) Mention any localities known to you in which a considerable increase in the use of manures has recently taken place.

(*e*) Has effect of manuring with phosphates, nitrates, sulphate of ammonia, and potash manures been sufficiently investigated ? If so, what is the result of such investigation ?

(*f*) What methods would you employ to discourage the practice of using cowdung as fuel ?

11. Crops.

(*a*) Please give your views on—

(*i*) the improvement of existing crops,

(*ii*) the introduction of new crops including fodder crops,

(*iii*) the distribution of seeds,

(*iv*) the prevention of damage by wild animals.

(*b*) Can you suggest any heavy yielding food crops in replacement of the present crops ?

(*c*) Any successful efforts in improving crops or substituting more profitable crops which have come under your own observation should be mentioned.

12. Cultivation.

Can you suggest improvements in—

(*i*) the existing system of tillage, or

(*ii*) the customary rotations or mixtures of the more important crops ?

13. Crop Protection, Internal and External.

Please give your views on—

(*i*) The efficacy and sufficiency of existing measures for protection of crops from external infection, pests and diseases.

(*ii*) The desirability of adopting internal measures against infection.

14. Implements.

(*a*) Have you any suggestion for the improvement of existing, or the introduction of new, agricultural implements and machinery ?

(*b*) What steps do you think may usefully be taken to hasten the adoption by the cultivator of improved implements ?

(c) Are there any difficulties which manufacturers have to contend with in the production of agricultural implements or their distribution for sale throughout the country ? If so, can you suggest means by which these difficulties may be removed ?

PART III

15. Veterinary.

(a) Should the Civil Veterinary Department be under the Director of Agriculture or should it be independent ?

(b) (i) Are dispensaries under the control of Local (District) Boards ? Does this system work well ?

(ii) Is the need for expansion being adequately met ?

(iii) Would you advocate the transfer of control to Provincial authority ?

(c) (i) Do agriculturists make full use of the veterinary dispensaries ? If not, can you suggest improvements to remedy this ?

(ii) Is full use made of touring dispensaries ?

(d) What are the obstacles met with in dealing with contagious diseases ? Do you advocate legislation dealing with notification, segregation, disposal of diseased carcases, compulsory inoculation of contacts and prohibition of the movement of animals exposed to infection ? Failing legislation, can you suggest other means of improving existing conditions ?

(e) Is there any difficulty in securing sufficient serum to meet the demand ?

(f) What are the obstacles in the way of popularising preventive inoculation ? Is any fee charged, and, if so, does this act as a deterrent ?

(g) Do you consider that the provision of further facilities for research into animal disease is desirable ?

If so, do you advocate that such further facilities should take the form of—

(i) an extension of the Muktesar Institute, or

(ii) the setting up, or extension of, Provincial Veterinary Research Institutions ?

(h) Do you recommend that special investigations should be conducted by—

(i) officers of the Muktesar Institute, or

(ii) research officers in the Provinces ?

(i) Do you recommend the appointment of a Superior Veterinary Officer with the Government of India ? What advantages do you expect would result from such an appointment ?

16. Animal Husbandry.

(a) Do you wish to make suggestions for—

(i) improving the breeds of livestock,

(ii) the betterment of the dairying industry,

(iii) improving existing practice in animal husbandry ?

(*b*) Comment on the following as causes of injury to cattle in your district—

(*i*) Overstocking of common pastures,

(*ii*) Absence of enclosed pastures, such as grass borders in tilled fields,

(*iii*) Insufficiency of dry fodder such as the straw of cereals or the stems and leaves of pulses,

(*iv*) Absence of green fodders in dry seasons,

(*v*) Absence of mineral constituents in fodder and feeding stuffs.

(*c*) Please mention the months of the year in which fodder shortage is most marked in your district. For how many weeks does scarcity of fodder usually exist ? After this period of scarcity ends how many weeks elapse before young growing cattle begin to thrive ?

(*d*) Can you suggest any practicable methods of improving or supplementing the fodder supply that would be applicable to your district ?

(*e*) How can landowners be induced to take a keener practical interest in these matters ?

PART IV

17. Agricultural Industries.

(*a*) Can you give any estimate of the number of days of work done by an average cultivator on his holding during the year ? What does he do in the slack season ?

(*b*) Can you suggest means for encouraging the adoption of subsidiary industries ? Can you suggest any new subsidiary industries to occupy the spare time of the family which could be established with Government aid ?

(*c*) What are the obstacles in the way of expansion of such industries as beekeeping, poultry rearing, fruit growing, sericulture, pisciculture, lac culture, rope making, basket making, etc. ?

(*d*) Do you think that Government should do more to establish industries connected with the preparation of agricultural produce for consumption, such as oil pressing, sugar making, cotton ginning, rice hulling, utilisation of wheat straw for card-board, utilisation of cotton seed for felt, fodder, oil and fuel, utilisation of rice straw for paper, etc. ?

(*e*) Could subsidiary employment be found by encouraging industrial concerns to move to rural areas ? Can you suggest methods ?

(*f*) Do you recommend a more intensive study of each rural industry in its technical, commercial and financial aspects, with a view to, among other things, introduction of improved tools and appliances ?

(*g*) Can you suggest any other measures which might lead to greater rural employment ?

(*h*) Can you suggest means whereby the people could be induced to devote their spare time to improving the health conditions of their own environment ?

18. Agricultural Labour.

(*a*) What measures, if any, should be taken to attract agricultural labour from areas in which there is a surplus to—

(*i*) areas under cultivation in which there is a shortage of such labour ? and

(*ii*) areas in which large tracts of cultivable land remain uncultivated ?

Please distinguish between suggestions designed to relieve seasonal unemployment and proposals for the permanent migration of agricultural population.

(*b*) If there is any shortage of agricultural labour in your Province, what are the causes thereof and how could they be removed ?

(*c*) Can you suggest measures designed to facilitate the occupation and development, by surplus agricultural labour, of areas not at present under cultivation ?

19. Forests.

(*a*) Do you consider that forest lands as such are at present being put to their fullest use for agricultural purposes ? For instance, are grazing facilities granted to the extent compatible with the proper preservation of forest areas ? If not, state the changes or developments in current practice which you consider advisable.

(*b*) Can you suggest means whereby the supply of firewood and fodder in rural areas may be increased ?

(*c*) Has deterioration of forests led to soil erosion ? What remedies would you suggest for erosion and damage from floods ?

(*d*) Can you indicate any methods by which supply of moisture in the soil, the rainfall and supply of canal water can be increased and regulated by afforestation or by the increased protection of forests so as to benefit agriculture ? Would the same methods be useful in preventing the destruction by erosion of agricultural land ?

(*e*) Is there an opening for schemes of afforestation in the neighbourhood of villages ?

(*f*) Are forests suffering deterioration from excessive grazing ? Is soil erosion being thereby facilitated ? Suggest remedies.

20. Marketing.

(*a*) Do you consider existing market facilities to be satisfactory ? Please specify and criticise the markets to which you refer, and make suggestions for their improvement.

(*b*) Are you satisfied with the existing system of marketing and distribution ? If not, please indicate the produce to which you refer and describe and criticise in detail the channels of marketing and distribution from the producer to the consumer in India (or exporter in the case of produce exported overseas). State the services rendered by each intermediary and whether such intermediary acts in the capacity of merchant or commission agent, and comment upon the efficiency of these services and the margins upon which such intermediaries operate. Please describe the method by which each transaction is financed, or in the case of barter, by which an exchange is effected.

(*c*) Do you wish to suggest steps whereby the quality, purity, grading or packing of agricultural produce may be improved, distinguishing where possible between produce destined for—

(*i*) Indian markets ?

(*ii*) Export markets ?

(*d*) Do you think that more effective steps might be taken to place at the disposal of cultivators, merchants and traders information as to market conditions, whether Indian or overseas ; crop returns ; complaints as to Indian produce from wheresoever originating ; and agricultural and marketing news in general ?

21. Tariffs and Sea Freights.

Do existing (*a*) customs duties, both import and export, and (*b*) sea freights adversely affect the prosperity of the Indian cultivator ? If so, have you any recommendations to make ?

22. Co-operation.

(*a*) What steps do you think should be taken to encourage the growth of the co-operative movement—

(*i*) by Government,

(*ii*) by non-official agencies ?

(*b*) Have you any observations to make upon—

(*i*) Credit societies ;

(*ii*) Purchase societies ;

(*iii*) Societies formed for the sale of produce or stock ;

(*iv*) Societies for effecting improvements—*e.g.*, the digging of wells and the construction of bunds, walls and fences, or the planting of hedges ;

(*v*) Societies formed for the aggregation of fragmented holdings and their redistribution in plots of reasonable size ;

(*vi*) Societies for the co-operative use of agricultural machinery ;

(*vii*) Societies for joint farming ;

(*viii*) Cattle breeding societies ;

(*ix*) Societies formed for any purpose connected with agriculture or with the betterment of village life, but not specified above ?

(*c*) Where co-operative schemes for joint improvement, such as co-operative irrigation or co-operative fencing or a co-operative consolidation of holdings scheme, cannot be given effect to owing to the unwillingness of a small minority to join, do you think legislation should be introduced in order to compel such persons to join for the common benefit of all ?

(*d*) Do you consider that those societies of which you have personal knowledge have, in the main, achieved their object ?

23. General Education.

(*a*) Do you wish to make observations upon existing systems of education in their bearing upon the agricultural efficiency of the people ? If you make suggestions, please distinguish, as far as possible, between—

- (*i*) Higher or collegiate,
- (*ii*) Middle school, and
- (*iii*) Elementary school education.

(*b*) (*i*) Can you suggest any methods whereby rural education may improve the ability and culture of agriculturists of all grades while retaining their interest in the land ?

(*ii*) What is your experience of compulsory education in rural areas ?

(*iii*) What is the explanation of the small proportion of boys in rural primary schools who pass through the fourth class ?

24. Attracting Capital.

(*a*) What steps are necessary in order to induce a larger number of men of capital and enterprise to take to agriculture ?

(*b*) What are the factors tending to discourage owners of agricultural land from carrying out improvements ?

25. Welfare of Rural Population.

(*a*) Outside the subjects enumerated above, have you any suggestions to offer for improving hygiene in rural areas and for the promotion of the general well-being and prosperity of the rural population ?

(*b*) Are you, for instance, in favour of Government conducting economic surveys in typical villages with a view to ascertaining the economic position of the cultivators ? If so, what, in your opinion, should be the scope and methods of such enquiries ?

(*c*) If you have carried out anything in the nature of such intensive enquiry, please state the broad conclusions which you reached.

26. Statistics.

(*a*) Do you wish to make suggestions for the extension or improvement of the existing methods of—

- (*i*) ascertaining areas under cultivation and crops ;
- (*ii*) estimating the yield of agricultural produce ;
- (*iii*) enumerating livestock and implements ;
- (*iv*) collecting information on land tenure, the incidence of land revenue and the size of the agricultural population ;
- (*v*) arranging and publishing agricultural statistics ?

(*b*) Have you any other suggestions to make under this heading ?

MINUTES OF EVIDENCE

TAKEN BEFORE THE

ROYAL COMMISSION ON AGRICULTURE.

Tuesday, November 9th, 1926.

BANGALORE.

Present:

The Marquess of Linlithgow, D.L. (*Chairman*).

Sir Henry Staveley Lawrence, K.C.S.I., I.C.S.
Sir Thomas Middleton, K.B.E., C.B.
Rai Bahadur Sir Ganga Ram, Kt., C.I.E., M.V.O.
Sir James MacKenna, Kt., C.I.E., I.C.S.
Mr. H. Calvert, C.I.E., I.C.S.
Professor N. Gangulee.
Dr. L. K. Hyder.
Mr. B. S. Kamat.

Mr. J. A. Madan, I.C.S. } (*Joint Secretaries.*)
Mr. F. W. H. Smith. }

Mr. W. SMITH, Imperial Dairy Expert, Bangalore.

Memorandum on the Animal Husbandry Section, Bangalore.

In submitting memoranda to a Commission some of the members of which are not intimately acquainted with Indian agricultural conditions, it is necessary in the first place to briefly state the present position of the cattle-breeding and dairy industry and its importance from the point of view of the agricultural well-being of the country.

This Section of the Imperial Agricultural Department which is under my control deals primarily with dairying and dairying means cattle-breeding and connotes the whole cattle industry. India, speaking in a general sense, does not rear cattle for beef and consequently milch cattle and plough bullocks are her cattle requirements, and as it takes a cow to produce a bullock and as the country cannot afford to have any cows which are not milk-producing cows, it follows that the dairy industry includes the whole cattle-breeding industry; the two are one and indivisible. The development of the dairy and cattle-breeding industry is by a long way the most important agricultural problem in India. The Indian agriculturist has more of his money invested in cattle than in any other capital form. It is more important than the growing of wheat or cotton or rice or any crop; it is as important and universal as the growing of all crops. India is a country of small fragmented holdings and the cultivation of the land cannot be done by tractors or by horses or mules, it can only be done so far as traction is concerned by the agency of the bullock so that the cultivation of every crop depends upon the efficiency of the working bullock, not only so but the primary transport of all crops produced must be done by the bullock. There is no doubt whatever but that the use of improved implements and machines for the cultivation and harvesting of crops has been and is being seriously retarded, because the cultivator does not possess a bullock of sufficient strength, size, weight or speed to work these improved machines and implements. The health and physical welfare of the whole of the people of India depends upon a plentiful, pure and clean supply of dairy produce. Great masses of the people of this country are vegetarians and I think it is admitted nowadays that in no form of vegetable fats can that particular growth principle be found which is so necessary for the proper development of the young. This growth element can only be found in animal fat, and as our people in the main do not eat flesh the only kind of animal fat they can use to attain the growth vitamines is milk fat. The milk-supply of India to-day is indescribably bad; it is filthy, expensive and scarce. No wonder the infant mortality in some of our large cities equals 666 per 1,000 infants from birth to one year old.

The cattle-breeding and dairy industry is also important because in its present state it imposes a colossal yearly drain on the wealth of the country. In India including Indian States there are at the present time 180,000,000 of all kinds of bovine stock, the total value of which may be taken as some nine hundred crores (nine thousand millions) of rupees. The majority of the people of India are Hindus and to the Hindus it is wrong to take animal life, not only so but it is a doubly heinous offence to take the life of any member of the ox tribe. The cow is sacred and is venerated by the Hindus from Peshawar to Tuticorin. Broadly speaking, the cattle-breeding industry in India is in the hands of ignorant jungly tribes who have no scientific knowledge of the principles of breeding or the practice of cattle-rearing, and consequently millions of absolutely useless scrub cattle are born in the country every year. These animals are so poor that they cannot do any work nor do the females yield any milk, yet having been born they cannot owing to the Hindu sentiment be killed and the country must keep them until they die. These animals not only yield the country no return outside of the value of their hide and bones when they die, but they consume the food which the working and milk-producing animal ought to get and as the males are not castrated they perpetuate their degenerate species all over the land. In any other country in the world these animals would be killed and utilised for food at the end of their third monsoon when they had sufficient flesh on their bones to pay for what they had eaten. Here they have a brief period of plentiful feeding each monsoon, followed by eight or more months of semi-starvation until they die, and their bones and hides are sold by the sweeper caste. A writer in the "*Madras Mail*" of 21st April, 1926, calculates that the loss to this country due to the upkeep of these useless cattle is not less than sixty-one crores and twenty lacs (six hundred and twelve millions) of rupees per annum. I cannot vouch for the correctness of this figure, but the drain on the wealth of the country due to this state of affairs is truly colossal and the foregoing shows the existing deplorable state of the cattle-breeding and dairy industry. It will be seen then that not only is the development of the cattle-dairy industry the most important problem facing Indian agriculture, but owing to the Hindu sentiment "thou shalt not kill the cow" it is the most difficult agricultural problem in India. The improvement of the quality of Indian crops or methods of Indian cultivation, and the education of the Indian cultivator are as easy here as they are in any other part of the world, but the cattle problem is hedged around by Hindu sentiment, and by reason of this sentiment it is not only the loss through the working and milking of inefficient cattle that India has to face, she has to foot a larger bill in supporting the altogether useless cattle which cannot be killed owing to the sentiments of her people. There is only one solution of the problem. Hindu sentiment will not change for a long time to come and the cattle-breeding and dairy industry must be raised to that high level of efficiency when the breeders of cattle will only permit efficient and suitable animals to be born and those only in such numbers as the country requires. Now not only is the cattle-breeding and dairy question the most important and the most difficult problem facing the Indian agriculturist, but it is the most universal. It must be handled from an All-India point of view. It cannot adequately be dealt with by Provinces or States, because the cattle-breeding policy and practice of one Province or State may largely affect the agricultural efficiency of another Province or State. Bengal, for instance, breeds comparatively few cattle and those she does breed are of poor quality. The Bengali cultivator to a large extent depends upon the breeders of Bihar and Orissa to supply him with his work cattle. Then again both Rangoon and Calcutta depend almost entirely on the Punjab for the supply of their milch cattle and Bombay draws its milking cattle from the Punjab and Sind. Not only is the question universal from this point of view, but over the whole country every caste, creed, and class uses milk and milk products freely in their dietary and cultivators of every part of India look for an efficient field ox. It would seem, therefore, that this question which is so vital to the agricultural and general progress of the country would receive very special attention at the hands of the Central Government. That it has not done so can be easily proved. In fact this great problem has been all along treated as the Cinderella of Imperial Agriculture as the following brief resume of facts will show.

In response to recommendations made by the Board of Agriculture at their meetings at Coimbatore in 1913 and Pusa in 1916 the Government of India in May 1920 appointed an Imperial Dairy Expert, and in July 1921 the appointment of a Physiological Chemist was made to carry out research work in connection with problems of animal nutrition. The recommendation made by the Board of Agriculture at the two meetings before referred to, besides the appointment of an Imperial Dairy Expert and a Physiological Chemist, recommended the establishment of dairy schools and of breeding farms on a moderate scale; but although I was appointed to the post of Imperial Dairy Expert in May, 1920, Government did not provide me with either money or facilities of any sort whatever to carry out any educational or research work until July 1923. In 1922, with the enthusiastic support of the Agricultural Adviser to Government, I requested Government to hand over to this department the thirty-four Military dairy farms in India so that they could be utilised as training centres, breeding farms and research stations. On the recommendation of the Inchcape Committee two of these farms with a small hill farm were handed over for educational and research purposes instead of thirty four asked for, and the farms handed over were only given on the understanding that they were to be self-supporting, or in other words that this department would provide that education so badly wanted, and carry out as well much needed research work without a penny of cost to the State.

The farms before referred to, which were taken over from the Military Department in 1923, are situated at Karnal in the Punjab and Bangalore or Mysore State with a branch of Bangalore farm at Wellington in the Nilgiri Hills. Then, in October, 1925, this department took over the Military creamery at Anand in Gujarat to be used, as a dairy factory school. The staff employed by the Military Department on the Bangalore, Wellington and Karnal farms were taken over with the farms. The laboratories of the Physiological Chemist to Government were moved from Pusa and the Bangalore farm was converted into a central teaching and research institution now known as the Imperial Institute of Animal Husbandry and Dairying. Three classes of pupils are taken on there for training from all parts of India, *viz.*:—

(1) Post-graduate pupils for advanced instruction in animal nutrition, animal husbandry and dairying.

(2) Pupils for the Indian dairy diploma granted by the Institute (2 years' course).

(3) Short course students for special instruction in specific subjects connected with animal husbandry or dairying.

The Karnal farm is utilised for the instruction of all three of the above classes of pupils and is primarily a cattle-breeding research station where three separate herds of pure Indian cattle have been established and which are being developed on pure lines.

The Wellington farm is merely a branch of Bangalore kept up to provide the British garrison in that station with pure milk and butter.

The Anand Creamery was acquired in order to provide factory instruction and to carry out research work in connection with the manufacture of *ghi*, butter, condensed milk, dried milk and factory milk products generally. I have just learned that Government may close down this factory because it is not paying. This creamery is situated in the one district in India where milk is available in large quantities, and where butter and casein are manufactured for home consumption and export. This Section cannot possibly carry out its work without one dairy factory of this kind. Indian factory methods of butter, *ghi*, and casein manufacture are crude, uneconomical and dirty. India imports large quantities of condensed milk, dried milk, and milk products of various kinds, all of which should be made in the country. Research and experiment of this kind is more necessary in India at the present moment than any other class of dairy work. In fact it is absolutely vital to India. It lies at the root of the whole cattle problem. It is no use improving the yield of the Indian cow or buffalo unless along with this improvement a market is provided for the milk of these animals. This can only be done in the rural areas by developing the manufacture of milk products. Nothing whatever is known about the scientific manufacture of any class of modern milk product from the milk of the buffalo. Present methods are crude, filthy and wasteful. The closing down of the research creamery at Anand would be a national disaster. The most urgent and pressing dairy problem in India to-day is the utilisation of by-products in the manufacture of *ghi*, and so far neither the Imperial nor any Provincial Government has touched the problem. This Section was preparing to do so at Anand.

So far outside of the actual staffs required to work the farms and formerly employed by the Military dairies no extra staff for educational and research work has been provided for this Section other than that a general assistant to the Imperial Dairy Expert was appointed in December 1925. Consequently the amount of research work undertaken has not been at all commensurate with the needs of the industry. The demand for dairy and cattle-breeding education at all the farms and the dairy factory has since the commencement of the concerns been far more than could be undertaken. Research work in the development of our two herds of Indian cows and the Indian buffalo herd at Karnal (the former on dual purpose lines, milk and draught, and the latter for milk production) is being caried out. Owing to paucity of staff and want of funds this Section has not yet been able to touch the fringe of the many pressing problems facing the cattle-breeding and dairy industry in its national aspect, consequently practically no results of research work done by this Section have so far been made available for the advancement of Indian agriculture.

Since my appointment as Imperial Dairy Expert in 1920 this Section has been in continual close touch with all the Provincial Departments of Agriculture, with the Corporations of the large cities and with most of the Indian States, *pinjrapole* societies, etc., and technical advice with building plans, machinery specification, etc., has issued from my office in a continuous stream since its inspection. The demand from all over the country for this class of information continues to increase and the supply of technical advice occupies a large part of my time and that of my assistant. I maintain a practically continuous correspondence with all the Directors of Agriculture in India, with many of the Co-operative Departments and with the cattle-breeding experts. My office is freely consulted by all the Departments of Agriculture in the country on matters connected with cattle-breeding and dairying, and in this respect I consider we have done, and are doing good work.

The training of post-graduate students at Karnal, Anand and Bangalore for the highest posts of the department is undertaken by this Section in co-operation with the Physiological Chemist to Government; and in my opinion this training could be improved by the provision of a scientific research staff at Bangalore and Karnal farms, but especially at the Anand Creamery under whom the post-graduate men could work.

I consider that our present facilities for giving short courses of study to persons connected with the cattle-breeding and dairying industry are good, but they would be improved by the addition of the scientific research staff above referred to.

The work of this Section has been carried on at all times in the most active and pleasant co-operation with all the officers of the Imperial Agricultural Department and as before stated with the Directors of Agriculture and expert cattle-breeding dairy officers of all the Agricultural and Veterinary Departments. This Section by reason of the class of work done has been more particularly in touch with the Agricultural and Bacteriological Sections at Pusa and in daily co-operation with the Physiological Chemist at Bangalore. On various occasions the Section has supplied detailed information regarding the position of the dairy industry in India to the International Institute of Agriculture in Rome.

Mr. W. Smith.

Replies to the Questionnaire.

Before dealing with those specific questions which pertain to cattle-breeding and dairying, I desire to make a few remarks regarding Question I (*b*), Research.

Question 1 (*b*).—The section of the Imperial Department of Agriculture under my control comprises the following units in addition to the office of the Imperial Dairy Expert:—

The Imperial Institute of Animal Husbandry and Dairying, Bangalore.
The Imperial Government Dairy Farm at Wellington.
The Imperial Government Cattle Breeding Farm at Karnal, Punjab.
The Imperial Government Creamery at Anand, Gujarat.

The office of the Imperial Dairy Expert was opened in May 1920, and the three first mentioned farms were taken over from the Military in 1923. The Anand Creamery was taken over in 1925.

All of these institutions are utilised as far as circumstances permit as teaching or research centres. The Imperial Institute of Animal Husbandry and Dairying grants a diploma in practical dairy farm management. The course for this diploma is a two years one, and the teaching for this diploma, in order to make it as varied and practical as possible, is given at Bangalore, Karnal and Anand Creamery. The number of students now under training for this diploma is 23 this being the maximum number which the existing hostel accommodation could provide for, but the actual number of suitable men who applied for tuition in the class now undergoing instruction was 69. In addition to the diploma students all the farms under this section and the creamery take men for short technical courses, as well as post-graduate students for special research work. During the past two years 74 short course students and 7 post-graduate students have taken courses.

The laboratory, cattle sheds and stores of the Physiological Chemist to Government are situated in the farm yard of the Bangalore Institute, and the scientific staff of this officer has up to the present very kindly undertaken the teaching of students in dairy chemistry, food analysis, and animal nutrition. I regard the animal nutrition work of the Physiological Chemist as of vital importance to the agriculture of India, and it has been the aim of this office to co-operate with him in every possible direction, but if the activities of this officer are to expand in the future as they have in the past the day is not far distant when there will not be room at the Bangalore farm for the Institute and the Physiological Chemist, and I am of opinion that in view of the magnitude and national importance of animal nutrition research a separate farm with herd, lands and scientific laboratories should be given to the Physiological Chemist, and that the existing laboratories and buildings now occupied by him at Bangalore be handed over to the dairy institute and utilised for teaching and research purposes on cattle-breeding and dairy problems. This eventuality was foreseen in 1924, as in that year this office suggested to the Government of India that the Hosur Remount Depôt, now the Madras Government Cattle Farm, then the property of the Imperial Government which was to be abandoned by Military Remount Department, should be handed over to the Bangalore Institute in order to permit of future extensions and to enable the Bangalore farm to grow its own fodder requirements. Up to the present this Section has been able to do very little in the direction of research work in connection with dairy problems. Experimental cattle-breeding work is being done at all three farms, but owing to lack of staff and funds, and to the fact that in the initial stages the energies of this office were concentrated upon the organisation of the farms as educational centres, little or nothing has been done to solve the many pressing problems affecting the dairying and cattle-breeding industry. The time has now come when this work should be undertaken on a purely national scale. In this connection please see my remarks on page 10 of this note regarding Anand Creamery. On the purely dairy side of the work the factory problems there referred to are most pressing. The following specific problems, I consider, call for immediate investigation:—

(1) The manufacture, storage and transport of *ghi*.

(2) The manufacture of condensed milk from the milk of the buffalo.

(2) The utilisation of the skim or butter milk a by-product from *ghi* manufacture, connoting the manufacture of dried milk, casein, milk sugar, skim milk cheese.

(4) The manufacture, storage and transport of butter under tropical conditions.

(5) Standardisation of Indian dairy products as regards purity.

(6) Testing and recording of the quality, *i.e.* chemical composition, of the milk of all the different well-known breeds of Indian cows and buffaloes.

(7) Transport of fresh milk for long distances in India including transport methods.

QUESTION 16 (*a*).—For two reasons it is vitally important that something should be done on a national scale to improve the breeds of cattle in India. Firstly the quality of the cattle of India grows worse from year to year. The introduction of modern and more efficient cultivating, seeding and harvesting machinery is being retarded, and the growing of every class of crop is adversely affected through the inefficiency of the plough bullock. Not only so but the general health and physical well-being of the whole community, rural as well as urban, is detrimentally influenced through the lack of a plentiful, cheap and safe supply of dairy produce, due to the inefficiency of the Indian milch cow.

Secondly owing to the Hindu sentiment regarding the killing of cattle and to the ignorance, apathy and want of skill on the part of the cattle breeders, this country is called upon to support continually millions of cattle which, from birth to death, are quite useless. They are not good enough to do any work or produce any milk. It costs the country anything from Rs. 15 to Rs. 30 per head per year to keep them. Their average life may be taken as 6 years and at the end of that time they die and the country gets Rs. 12 to Rs. 15 per head for their skin, horns and bones. Not only so but these perfectly useless animals eat up the fodder which should go to the fairly efficient workers and milkers, and thereby impair their utility. Again in the districts which support these animals, castration is not generally practised and the miserable half starved males roam about perpetuating their species and further reducing the quality of the cattle of the country. It is difficult to estimate how much this drain on the wealth of India amounts to. That it reaches a colossal figure yearly is certain.

Cattle-breeding and dairying in India, I regard as one and indivisible. This is mainly a vegetarian country and beef has no value, nor will the people of India work the female of the ox tribe in the plough or the cart, so that what the country wants is efficient draught bullocks and profitable milking cows. It being particularly borne in mind that almost every animal born must be permitted to live and must be fed. We cannot destroy the poor field worker nor the worthless cow. The country is saddled with whatever its cows give birth to, and it cannot afford to keep a cow just good enough to be the dam of future generations. In order that the cow shall pay for her keep she must, seeing she is prevented by custom from doing field work, give sufficient milk to rear her calf and in addition as much as will be equal in value to the cost of her maintenance. For India therefore we require for all districts a suitable type of dual purpose animal, the male being efficient as a field worker and the female as a milker. It has, I think, been demonstrated now that such cattle are obtainable and that many of the best breeds we have in India, possess these dual qualities.

Mr. W. Smith.

If the foregoing accurately describes the position then the solution lies in:—

(1) The development of pedigree herds on dual purpose lines, suitable for each district.

(2) The careful distribution and supervision of bulls from these herds.

(3) The development simultaneously with (1) and (2) of technical dairying and especially the co-operative handling and sale of milk, production and sale of *ghi*, and manufacture and sale of milk products, all as village industries.

(4) The dissemination of knowledge regarding the breeding, rearing and feeding of cattle and the growing and conservation of fodder crops for their maintenance.

(5) The extension of the Civil Veterinary Department to give better service in the detection, prevention and cure of animal diseases.

With regard to (1) the formation of pedigree herds. My experience in India follows that of the world of animal breeders in general that successful breeding cannot be done with a mongrel sire. There was probably a day in the history of India when the dedicated or Brahmini bulls, used mainly for breeding purposes throughout the country were the best that could be procured. At that time huge more or less isolated ranching areas were available for cattle-breeding where there was little or no admixture with different types of cattle from other parts of the country, but the spread of irrigation canals, the reservation of forests, and the general increase of the cultivated area has driven the cattle-breeding clans into the rough jungle tracts, and the improvement of roads, the establishment of railways and the general advance in transport and means of communications, has so mixed up the one time breeds of cattle in India, that most of the bulls now used as sires can be truly classed as mongrels. Added to this is the fact that in India as in other parts of the world, religious fervency has declined and the Brahmin, who now dedicates a bull on the birth of his son, is often more concerned in obtaining an animal at a moderate price than with getting the best possible breeding bull. In this connection please see copy of this office letter No. 2925-A., dated 6th January 1926 (Appendix I), addressed to the All-India Cow Protection Society. The pedigree herds of cattle in Great Britain, which have formed the foundation stock of more than half the cattle in the world's temperate zones, were built up by private individuals and the various now well-known breeds were evolved or created at the expense of private enterprise, and it has been stated that the same procedure must be followed in India. I give it as my opinion that this cannot be done here and if India is to wait until her private cattle owners, at their own expense, build up pedigree breeds of cattle, she will wait until the crack of doom. The conditions are very different. In Europe the commercial value of beef enabled the far-sighted breeder to dispose off his rejections, which in the initial stages must be numerous, at an economic figure and he could knock on the head at birth any very weedy calves. In India the flesh of cattle has little or no value as food and if it had, no self-respecting Hindu breeder would sell his cattle to a butcher nor will he kill worthless calves. The building up of pedigree herds in India must be a losing business for many years to come and therefore it can only be done by the State. No amount of propaganda or official persuasion will induce Indian landed proprietors, cultivators or business men to undertake this work because although it will in time yield a handsome return to the country in the increase of wealth due to enhanced cattle efficiency yet, the loss or cost to the person, company or State which does this pioneer work will be heavy. Government cattle-breeding farms in India cannot be expected to pay their way for many years to come and this fact has been emphasised by the Board of Agriculture.

Regarding the second recommendation of this note—the distribution and control of pedigree bulls. This is a work which will require very special attention. It may be done through local boards, village panchayets, co-operative societies or other agencies, and along with this must go an organised system for the castration of all unfit males. Bearing in mind the fact that in most parts of India cattle once born cannot be killed or sold for beef, it will be realised how important it is that only the number of cattle actually required by the country should be begotten and only efficient and healthy animals should be brought into world. We have far too many cattle in India. What we want is fewer cattle, but all of them efficient and profitable. The aim of the Agricultural Departments from a breeding point of view should be suitable bull or bulls in every village, properly controlled and supervised. This is not an impossible dream. It has already been done in some parts of the Punjab where owing to the energetic action of the Government of that Province, the decline in the quality of cattle has been stayed.

We are at the parting of the ways in India in regard to this cattle-breeding problem. This country like all other countries at some stage of their development, has reached the point where it can no longer afford to set aside huge areas for breeding cattle on the ranching system, because it now requires these areas to grow food for its people and cotton to clothe them. Owing to want of knowledge on the part of those closely interested in stock breeding, the cattle of the country have got into such a mixed up condition that it is not profitable for the cultivator to breed his own animals. It must therefore be the aim of all interested in agricultural propaganda and progress to demonstrate to the cultivator that he must breed and rear cattle and that if he uses the right breeds and practises the correct methods, cattle-rearing and the growing and conserving of fodder crops for this purpose as a regular part of his agricultural operations will be profitable. There is no use telling the cultivator this. It must be demonstrated to him before his eyes, and it cannot be demonstrated until he can be offered the services of a bull which will be certain under specific condition to produce an efficient field bullock and a profitable milch cow, and it is at this juncture that the third proposal of this note (the development of technical dairying) comes in. It is not merely necessary to enable the cultivator, who must be the breeder of the future, to produce a milk-yielding cow. He must be taught how to economically utilise the milk of this animal. The milk producers of India to-day are steeped in technical ignorance and superstition. The methods of manufacture of *ghi* and the various forms of Indian cheese and partially evaporated milk are filthy and wasteful, so much so that at the flush season of the year in many of the *ghi*-producing tracts the butter milk or by-product from *ghi* manufacture containing all the valuable casein albuminoids and milk sugar is thrown away. Apart from this aspect of the question, India badly requires village industries to provide additional sources of employment and to generally increase the standard of village life. What industries are more suitable for this purpose than the manufacture of *ghi*, country cheese, casein and dried milk, etc., on a small factory scale owned and managed on co-operative principles. With the aim of encouraging this phase of dairy development, I started a class for the instruction of officers of the Co-operative Departments of all the Provincial Governments and Indian States, at the Imperial Institute of Animal Husbandry and Dairying at Bangalore. The first class held in 1925 was attended by some 26 officers from most of the Provinces and principal Indian States. The Government of India authorised this class but in doing so they gave it as their opinion that in giving instruction of this nature the Imperial Department of Agriculture were encouraging on the functions of the Provincial Departments of Agriculture. I attach copy of a letter from the Registrar of Co-operative Societies, Punjab, to the Government of India and a copy of the reply of the Government of India to the same (Appendix II), from which it will be seen that the Government of India expect a recommendation from the Royal Commission on Agriculture regarding this matter and the Royal Commission on Agriculture may consider the advisability of communicating their views to the Government of India at a date earlier than the submission of their full report.

Up to the present none of the agricultural colleges in India has attempted to give instruction in dairy factory work nor has any experimental work been done on the very important problems such as the manufacture of *ghi*, casein, or other milk factory products. In October last the dairy section of the Imperial Department of Agriculture took over the disused Military Creamery at Anand in Gujarat, for the purpose of utilising it as an instructional centre for creamery work and for experimental work in connection with dairy factory problems. The working of this creamery has not, owing to severe competition in the fresh butter market and for other reasons, been as profitable commercially as I had hoped and consequently the Government of India, I understand, contemplate closing it down. In this connection I attach copy of a letter addressed to the Agricultural Adviser to Government, on June 16th, 1926 (Appendix III) and with a view to advising the Government of India concerning the retention or otherwise of this creamery, the Royal Commission on Agriculture might consider the advisability of some of its Members visiting this creamery and inspecting the local butter and *ghi* factories in Gujarat, the greatest milk-producing district in India. As an indication of the conditions now prevailing in the Gujarat dairies, I may mention that the Bombay Cattle Commission which consisted of 5 distinguished Indians and 2 Europeans described these places in paragraph 31 of their report published in 1923 as reproduced below:—

"The Committee whilst touring in Gujarat took the opportunity of visiting some of the so called dairies in Ahmedabad where the bulk of the butter and other dairy produce is manufactured for the whole of India. The Committee were surprised to find that this industry is carried out under the most filthy and dirty conditions imaginable. These so called "dairies" are situated in the most insanitary by-lanes of the city. The butter produced under these conditions is sold all over India and a certain amount is exported (even to Great Britain). It is a well-known fact that milk and its products are best medium possible in which injurious bacteria and germs of typhoid, diptheria, cholera, etc., thrive and in which they are carried and spread over the whole of India. It is essential for the public health that production on honest and scientific lines should be made a financial success, so that the public at large will get a safe and sure supply of milk and its several products."

Owing to lack of funds and the attempt to obtain commercial results from what are educational and research institutions, no research work has yet been done in connection with such pressing problems as:—

(*a*) the manufacture, storage and marketing of *ghi* in large and small quantities;

(*b*) the manufacture of casein, condensed milk or dried milk from buffaloes milk;

(*c*) manufacture of *panir* (Indian cheese) from skim-milk.

This kind of research work can only be properly carried out at an experimental dairy factory situated in the premier milk-producing area, Gujarat. It is useless to attempt this class of experiment with milk produced by Government cattle fed, housed, and looked after under perfect conditions at the Government owned farms at Bangalore and Karnal. This work must be done on a factory scale with purchased village milk produced under ordinary working conditions and adulterated, as the village producer will insist on adulterating it. Within the last 20 years India has lost the valuable butter export trade to the Far East because of the inferior quality of her butter due to lack of technical knowledge of methods of manufacture. For the same reason the value of Gujarat casein in the world's markets is only half of the French and New Zealand product. The site of the Anand Creamery is most suitable, the land on which the creamery stands is already the property of the Imperial Government, and the closing of this creamery before it has even begun its much needed research work would, I think, (as I have stated in my letter to the Agricultural Adviser to the Government of India) be nothing short of a national calamity. In this instance also, and in view of the urgency of the question, the Royal Commission may consider the advisability of communicating with the Government of India at an early date.

Mr. W. Smith.

The cultivator in India knows how to make use of his bullock, but he does not possess the most elementary knowledge of how to make profitable use of the surplus milk from his cows or buffaloes. Along with the improvement of quality of his cow he must be taught how to utilise his milk to the best advantage.

In dealing with the fourth recommendation of this note it is unnecessary to say much. Vigorous propaganda by means of cinema films, lantern slides, lectures and last but not least small demonstration farms, where profitable cattle are employed and where the benefits of mixed farming with stock breeding as an essential part, could be shown in operation.

As regards item five of the recommendations of this note, I regard the work of cattle-breeding, rearing, feeding and management as coming under the sphere of agriculture rather than veterinary operations. There is so much scope for the skilled veterinary officer in the sphere of the prevention and cure of animal diseases that I consider he cannot profitably be asked at this juncture to take up such purely agricultural problems as the breeding and rearing of livestock.

Before dealing with the minor points raised in the Questionnaire, I desire to call attention to the national aspect of this cattle-breeding question and the necessity for some form of central authority for dealing with it. The Board of Agriculture recognising this have at their meetings at Bangalore in 1924 and at Pusa in December 1925 recommended the establishment of a Central Cattle Bureau. This has been commenced with a small clerical staff and the Imperial Dairy Expert as Secretary and it is understood that the Government of India have under consideration the formation of a representative board or committee, as recommended by the Board of Agriculture at their Pusa meeting in 1925, to control the operations of the Central Cattle Bureau. The functions of this Bureau under the control of a Committee represented of all the Provincial Governments and Indian States would be to establish and control herd books, to supervise and authenticate milk records, to keep all Governments and breeders in touch with the cattle-breeding activities of other breeders; and the Bureau, if given sufficient staff and funds, will do a useful and very necessary work in India, but the cattle-breeding dairying problem is so universal to the whole country and so important nationally that I consider some greater degree of central co-ordination and guidance is necessary than can be exercised by the Central Cattle Bureau. It is I think certain that Bengal, by reason of the nature of its soil and climate, will always require new blood for cattle-breeding from other Provinces of India. Calcutta at present procures the whole of its milch cattle from the United Provinces and the Punjab. Bombay is largely dependent for its supply of milch cattle on the Punjab. The Province of Sind supplies milch cattle to many districts in India and Burma, and Rangoon imports cattle regularly from the Punjab and Bihar. Then there is the question of control of the export and import of cattle which must always be in the hands of the Government of India. The time is perhaps not yet ripe for the restriction of the movements of cattle to prevent the spread of disease, but this will come some day and when it does it will have to be controlled by the Central Government. The question of milk standards, standards of purity for *ghi*, butter and other dairy products, should be the same all over the country and generally speaking this cattle-breeding dairying question is so universal, its development so vital to the whole country that if at all possible the Government of India should retain some sort of central control over it. This might best be done by the Central Government giving substantial grants to Provincial Governments for cattle-breeding dairying, conditional on the money being spent on work approved of by the Central Government, or if the control of the Government of India was objected to the central authority might take the form of a central agricultural council representative of all the Provincial Governments and Indian States with small executive committees of experts to deal with each of the special phases of agriculture in the country.

QUESTION 16 (*b*).—My district is the whole of India and Burma, and consequently in this note I have attempted to deal with the whole question from a national as opposed to a provincial point of view. In most cases what remains of the common pastures are overstocked, and they will be so until the cultivator becomes a breeder and until he realises that he can make money by breeding and rearing cattle and growing and conserving fodder for this purpose. He will only be able to do this with some degree of assistance from the State in the direction of:—

(*a*) The provision and control of suitable sires.

(*b*) Education, by demonstration and otherwise concerning breeding and rearing of cattle and the utilisation and sale of dairy produce.

After all every country in the world which has tackled the improvement of its cattle has employed some system of *State aided* bull provision and distribution. In the more developed countries the premium bull system is in operation to-day. Here we must produce the pedigree bull to commence with as he is not otherwise available. It is the recognised function of every State to provide not only elementary education but technical education for its people. Dairying on village factory lines has greatly added to the wealth of all the most progressive nations of the world, and India cannot afford to refuse technical education on this subject.

Grazing on the cultivated tracts and especially the irrigated tracts in India is a waste of land. What the Americans term "siloin" is the most economical way of feeding cattle, outside of the jungle tracts, in India. This question will only be solved when it can be made profitable for the cultivator to rear cattle and to grow and conserve the necessary fodder for their maintenance. At the same time much could be done all over India by the conservation of the surplus green grasses of the coarser types, during the rains, by means of pit silos. The making of this class of silage is simple, inexpensive and certain in its results. The system, I think, only requires to be demonstrated to make it universal. It is not practised because its value is unknown and no ordinary cultivator will believe it can be done until it is actually demonstrated to him. If in India we only breed sufficient efficient cattle for our requirements, and if by means of silage we conserved the green fodder which is wasted every year by being allowed to run to woody fibre after the rains there would be no shortage of roughage in this country.

The only way in which landowners can be induced to take a keener practical interest in the cattle-dairy industry is by demonstrating to them that the use of pedigree sires and the adoption of modern methods are financially profitable and this cannot be done as explained in this note, until by State assistance pedigree has been created. In most parts of India the scarcest months of the year for fodder-supply are April, May and June.

The question of the mineral contents of fodder can best be answered by Mr. Warth, but it is certain that in many parts of the country the local fodders are deficient in mineral matter.

I desire to bring to the notice of the Royal Commission a disability under which the Indian cattle trade labours in connection with the transport of milch cattle by passenger train. Indian cows are useless as milkers unless their calves accompany them and the railway companies including State railways charge the same amount for the carriage of a newly born calf by passenger train as they do for a full grown cow or bullock. This is a very great hardship, the cow is no use without the calf and consequently the calf if sold apart from the cow has no value. Besides it does not seem fair that the same rate of freight should be charged for a newly born calf weighing 30 lbs. and of no commercial value as for a cow or bullock weighing say 800 lbs. and worth Rs. 250 to Rs. 500.

APPENDIX I.

Letter No. 2925-A., of 1926, dated Bangalore, the 6th January 1926, from W. Smith, Esq., the Imperial Dairy Expert, Bangalore, to the Honorary Secretary, the All-India Cow Conference Association, Calcutta.

I offer the following remarks on the cattle-breeding scheme sent with your letter:—

To my mind every Province in India *requires* good milch cows and efficient working bullock. My experience goes to show that in Madras of all the Indian Provinces, outside of the immediate vicinity of the larger cities, little or no attention is paid to milk production as a factor in selection for breeding, consequently I cannot agree with you that in this Province "good milkers are keenly appreciated." I do not agree that the advent of British rule either upset the course of Indian social life or ignored the cattle-breeding systems of the country.

I agree with Mr. Blackwood's remarks that the Brahmini system of bull distribution so long as it was the result of strong religious fervour served a useful purpose, but these days I fear religious feeling is not as strong as it was. I have on more than one occasion sold a bull to a Hindu to be dedicated, branded and turned loose and the buyer was by no means anxious to secure the best bull available but he was most anxious to buy the cheapest bull he could get, and in this decline of religious fervour, common to the whole world, these days, lies the reason for the decline in the quality and number of Brahmini bulls. In short the system has outlived its day and is now quite unsuitable.

I think it is rather antiquated to-day to quote, at length from reports prior to 1914. Even the cattle-breeding-dairy industry in India has made great strides since that date. I entirely concur that the importation of foreign blood is not a practical proposal for the improvement of the village cattle in India but this and all the remarks made on pages 4, 5 and the first paragraph of page 6 of your note are common knowledge to all who have studied the cattle question in this country. I do not agree that the Brahmini bull is an indispensable factor in improving the breed of Indian cattle. On the contrary the Brahmini system is a broken reed and is to a considerable degree responsible for the present unsatisfactory condition of affairs. The provision, distribution and control of the breeding bulls of the country should be entirely apart from any religious community, sect or organisation whatever and should in no way however remote be dependent on religious or other like sentiment. It is matter of business of serious moment to the whole country. I entirely agree that we need better breeding bulls, better methods of selection, rearing, feeding and management, and no scheme which does not include ways and means of growing and conserving fodder, of controlling the distribution and service of stud bulls, of castrating unsuitable males and of encouraging and developing not only the production of milk but its handling, transport and sale and the manufacture of milk products will really solve this question. Your note gives no details of how all these important matters are to be dealt with and consequently fails to solve this pressing and important economic problem. In short I consider your brief note on the whole states the existing position with care and makes out the need for improvement concerning which we are all agreed, but it is far too vague and incomplete to be classed as a "scheme" for the improvement of cattle-breeding in India.

As all the estimates given in the last page of your note depend upon the use of so called "Brahmini" bulls supplied free I cannot accept your figures.

This is an economic matter, a purely business question and it cannot be solved by an appeal to the religious susceptibilities of any one section of the community.

Mr. W. Smith.

APPENDIX II.

Letter No. 688-R., dated Lahore, the 22nd June 1926, from C. F. Strickland, Esq., I.C.S., Registrar, Co-operative Societies, Punjab, to the Junior Secretary to Financial Commissioners, and Deputy Secretary to Government, Punjab, Development Department.

With reference to correspondence ending with your letter No. 2313-D, dated 1st June 1926, I have the honour to state that the attendance of two gazetted officers and six inspectors at the three months' course in Co-operative Dairying held at Bangalore last cold weather proved to be extremely profitable to the officers concerned, and the students from the Punjab were reported by the Imperial Dairy Expert to be the best who attended the class. Since their return they have been usefully employed in the formation of Milk Recording and Cattle-Breeding Societies in the course of their ordinary duties.

The sanction to sending these officers to the class was granted by your letter No. 656-D., dated the 5th August 1925, and provision has been made in my budget for the current financial year for sending an equal number of officers again to the course in Bangalore. I am now informed by the Imperial Dairy Expert that the Government of India are unable to sanction the admission of Punjab students to the course, but after personal inquiry I understand that this order is due to an apprehension that the Government of India, in undertaking a training class of this nature, may be thought to be trespassing in the sphere of Provincial Governments. The Imperial Dairy Expert is I understand extremely anxious to repeat the course this year, and I feel that it would be of the highest value to my staff. It is not possible to obtain in the Punjab a similar training, either at Lyallpur or elsewhere, and I feel that the anxiety of the Government of India would be removed if the Punjab Government were willing definitely to ask for permission to send Punjab students to Bangalore. The course began last year on September 15th, and there is therefore only a short time remaining within which the arrangement can be made. I beg that, if there be no objection, from the side of the Punjab Government, the Government of India may be moved to sanction the admission of my students.

The financial provision exists in my budget, and no additional expenditure will therefore be involved.

Letter No. 518-D(S)., dated the 13th July 1926, from the Financial Commissioner and Secretary to Government, Punjab, Development Department, to the Secretary to the Government of India, Department of Education, Health and Lands.

I am directed to say that by an arrangement made with the Imperial Dairy Expert, two gazetted officers and six inspectors of the Punjab Co-operative Department were admitted to the three months' course in Co-operative Dairying held at Bangalore last cold weather. The training thus received by these officers, has proved extremely profitable and the students from the Punjab were reported by the Imperial Dairy Expert to be the best who attended the class. Since their return they have been usefully employed in the formation of Milk Recording and Cattle-Breeding Societies in the course of their ordinary duties.

2. The Registrar, Co-operative Societies, Punjab, has now been informed by the Imperial Dairy Expert that the Government of India are unable to sanction the admission of the Punjab students to this course in future. It is not possible to obtain in the Punjab any similar training either at Lyallpur or elsewhere, and the Punjab Government (Ministry of Agriculture) is anxious to secure for its Co-operative Department Officers the very useful technical and specialised instruction imparted at Bangalore. It is understood that the Imperial Dairy Expert wishes to repeat the course this year, and is willing to take Punjab students if he is permitted to do so.

Mr. W. Smith.

3. The Punjab Government (Ministry of Agriculture) hopes that the Government of India will consent to assist it in obtaining for its officers the advantage offered by the course, and I am accordingly to request that the sanction of the Government of India may be accorded to the admission of the same number of students to the course to be held this year at Bangalore. All travelling and other expenses connected with sending the students to Bangalore will of course be met by this Government.

Letter No. 1458-Agri., dated Simla, the 31st July 1926, from J. W. Bhore, Esq., C.I.E., C.B.E., I.C.S., Secretary to the Government of India, Department of Education, Health and Lands, to the Financial Commissioner and Secretary to the Government of the Punjab, Development Department.

From a perusal of your letter No. 518-D. (S.), dated the 13th July 1926, it would appear that the Government of the Punjab are under the impression that a course in Co-operative Dairying will be held in Bangalore this year, but that students from the Punjab will not be allowed to attend. I am directed to say that this is not the case. The Government of India have decided not to hold such a course this year.

2. They have given their careful consideration to the question whether central institutions, which are intended primarily for research and for instruction of a post-graduate character, should also make provision for elementary short courses such as the one in question and they have come to the tentative conclusion that agricultural or veterinary education not of an advanced character falls more appropriately within the province of Local Governments than of the Government of India. It is possible however that the Royal Commission on Agriculture may make recommendations concerning the division of functions in regard to agricultural and veterinary training between the Central and Provincial Governments which may influence the Government of India to alter this provisional decision. Should this be the case and should the co-operative dairying course or similar classes be instituted by the Government of India, they would welcome the support of these educational activities by the Provincial Governments. For the reason indicated, however, the Government of India do not propose this year to hold the short course in co-operative dairying.

APPENDIX III.

Letter from Mr. W. Smith, Imperial Dairy Expert (on leave), Colinton, Midlothian (Scotland), dated the 16th June 1926, to the Agricultural Adviser to the Government of India, Pusa.

I have been advised by the Assistant Imperial Dairy Expert who is at present acting for me that the Government of India contemplate the closing of the Anand Creamery because they are not satisfied with the trading results of that institution up to date. In the first place, I desire to point out that it is impossible to gauge the commercial success or otherwise of such a factory in the short space of time that Anand has been worked by this department, because owing to delay in the issue of orders as to the taking over of this creamery by the Imperial Agricultural Department it was impossible to commence operations until the cheap milk season, when profits are made in the Gujarat butter trade was past. Secondly, I desire to call the attention of the Government of India to the great national importance of maintaining and extending this, the one creamery or dairy factory, educational and research station, in the whole of the Indian Empire. To take one aspect of the dairy factory problems which to-day deeply affect the economic position in India—the *ghi* problem—the position is serious. The value of the *ghi* produced in India yearly cannot be below Rs. 1,00,00,00,000 per year and it is no exaggeration to say that the existing systems of *ghi* manufacture are crude, wasteful and filthy. These methods are not only wasteful in the outturn of *ghi* which they give from a given quantity of milk containing a certain percentage of butter fat, but they are doubly wasteful in that they make no provision for the proper utilisation of the by-product of *ghi* manufacture, namely separated or butter milk. In many of the districts where *ghi* is made in enormous quantities by jungli tribes who own large herds of buffaloes, the butter milk is simply thrown away in the flush season. This butter milk contains more than half the nutritious constituents of the milk in a highly digestible form, and the present value of dried separated milk in India at the ports is some Rs. 700 per ton. It is certain that under present conditions India deliberately wastes a sum of not less than Rs. 5,00,00,000 per year in failing to make proper use of the by-products in the manufacture of *ghi* and if to this sum there is added another Rs. 3,00,00,000 per annum as representing the actual loss in *ghi* outturn due to crude methods of manufacture, we have the truly colossal loss to the wealth of India of Rs. 8,00,00,000 per annum due wholly to want of technical knowledge and organising ability on the part of those engaged in the *ghi* industry.

It was primarily for the purpose of tackling this pressing problem and of attempting to in some degree prevent this enormous drain on the wealth of India that I pressed Government for so many years to take over the Anand factory and it was mainly with this end in view that I inaugurated classes for the instruction of officers of the co-operative departments of Provincial Governments and Indian States. This *ghi* question and in fact the whole question of manufactured dairy products cannot be investigated or dealt with outside of a properly equipped dairy factory situated in one of the milk-producing areas. No better situation and no more suitable factory site is obtainable than Anand, and to close down this creamery before it has even commenced its work of education and research will be a truly national calamity. The dairy section of the Imperial Agricultural Department cannot do its duty by the country without a thoroughly equipped modern dairy factory and it seems inconceivable that the Government of India will close Anand Creamery and build and equip another creamery at some other place. This question of manufactured dairy products such as *ghi*, condensed milk, evaporated milk and curd products is a truly national one. Every Province, and State, in India manufactures and consumes *ghi* to a greater or lesser extent and *ghi* is manufactured, adulterated, and re-transported from Province to Province all over the country. Not only is this question national from this point of view but it is even more truly national from the public health aspect. It is safe to say that there is no food product so universally consumed by all castes and classes as milk, *ghi*, and the milk products; and it is certain that there is no food product eaten in India which is manufactured, handled and adulterated with such filth and utter disregard to cleanliness as *ghi*. *Ghi* is offered for sale in every bazar in India adulterated with every known form of fat from petroleum jelly to the fat obtained by steaming the bones of dead animals. Surely the prevention of this abominable state of affairs is a national question, and this can only be done by the dissemination of knowledge of improved methods, and by the education of the dairy trade. Very little is at present known as to the best methods of manufacture of *ghi* and the milk products from buffaloes milk, research and experiment in this direction is most urgently needed, in fact the whole country is crying aloud for it. This kind of work can only be done at a State dairy factory such as Anand.

The importance of the *ghi* industry alone (only one branch of the dairy factory industry) is certainly of equal magnitude to that of the steel industry in India, and yet the Government of India are paying yearly in bounties to one steel manufacturing company more than the total cost of the Imperial Agricultural Department. I suggest in view of the foregoing that instead of closing down Anand Creamery, the Government of India make provision to extend its activities, and do something for this hitherto neglected but nationally important industry.

Mr. W. Smith.

Oral Evidence.

A.1. *The Chairman:* Mr. Smith, you are the Imperial Dairy Expert?—Yes.

A.2. You have put in a very interesting note, for which the Commission is indebted to you. Would you like to make any general statement at this stage, or shall I ask you a few questions?—I think you had better ask me a few questions.

A.3. I have your note of evidence before me, and your statement seems to me very clear and complete. But there are one or two details as to which I should like to ask you. On page 6 you say, "I regard the animal nutrition work of the Physiological Chemist as of vital importance to the agriculture of India, and it has been the aim of this office to co-operate with him in every possible direction." I take it that the work of the Physiological Chemist is only at its beginning for the moment?—Yes, it has been going on since 1920, about six years.

A.4. There is a great deal of work still ahead?—Yes.

A.5. And it is your view that the quantity of this work is likely to grow and that a separate herd at a separate farm is really likely to be required in the near future?—I entirely agree.

A.6. On page 7, you make out a case for a dual purpose animal. What indications are there that it is going to be possible to evolve a dual purpose animal, likely to thrive over the greater part of India?—The best breeds we have in the country to-day, such as the Hariana, are dual purpose animals. The Ongole breed in this part of the country and the Scindi in parts of Sind, as well as other less clearly defined breeds, have the dual purpose qualities now. In fact, the best breed of bullocks we have, with perhaps one exception, that of the Amrit Mahal, comes from animals which are largely dual purpose.

A.7. You see no reason why those breeds should not be in a position to provide dual purpose cattle for all the climatic and geographical conditions in India?—Certainly none. The quality of giving milk is the mark of maternity and I know of no reason why a first class mother should not be the dam to a good class of bullock of any type you like.

A.8. I wonder whether you could let the Commission have, at your convenience, a list of the breeds of which you have experience, with any facts about them that you think might be interesting?—I could do that with pleasure. (See Appendix I on page 46).

A.9. On page 8 of your note of evidence, you state the changing conditions which have brought about the contraction of the jungle-feeding grounds available for cattle. In connection with that, have you anything to say, from your experience, about forest management in relation to the fodder problem?—No, I have had very little experience; what experience I have had in dealing with the Forest Department with regard to this problem was in the Military dairy farms, and we found them very ready and willing to co-operate in every possible way.

A.10. Have you anything to say about the preservation of fodder in forests as an insurance against fodder famine?—I think the conservation of fodder or the preservation of fodder is one of the most acute problems in the country to-day, and the storing and conservation of fodder in forest areas would be useful along with that produced from all other types of land in the country.

A.11. On page 9, you point to the castration of unfit males as being an essential step towards the improvement of cattle breeds in India. What degree of prejudice against castration have you met with?—It depends on the locality and the caste of the people. Amongst the Jains in parts of Gujarat, of which I have had a good deal of experience, they simply will not do it at all. I have seen villages in Northern Gujarat, after two or three good years, with as many as 120 buffalo bulls, which were quite useless as breeders, wandering about the outskirts of the village, none of them castrated. In the Punjab, where you have a large Mahommedan population, and other parts of India, there is very little prejudice. In the stricter Hindu areas there is some prejudice, but I believe it is gradually breaking down. I do not think it is a serious matter to-day, because you can have bloodless castration, which most of the castes will agree to.

A.12. Is it done by crushing?—It is done by the Italian method of simply severing the cords by means of forceps and pressure.

A.13. While on the subject of prejudice, is there any sentimental objection to weaning?—There is a good deal of that in the country. It is entirely prejudice. I do not think it is supported, as far as I can find out, by any real religious teaching on the subject, but there is a prejudice against it. I think it can be overcome. The prejudice exists more among the lower orders who have to deal with cattle, that is, the men who actually attend on them. When I was in the Military dairy farms, we introduced a regulation to that effect and enforced it rigorously, and after the first year or two there was no trouble whatever.

A.14. Does it exist with regard to buffaloes with equal intensity?—No.

A.15. I do not know whether you could enlarge at all on what you have said, on page 9, about the successful experiments in parts of the Punjab in the matter of providing good pedigree bulls?—Probably, detailed information of that sort had better come from the Punjab Government. I have control of a farm in the Punjab, and I am fairly well acquainted with that part of the country. I have spent a good deal of my life there, and certainly the effect of the bulls issued by the Punjab Government is shown in that part of the country where they have been doing it for so many years. It is clearly shown, and to my mind it has effected a distinct improvement. I think the Punjab Government would have done well to have paid more attention to milk in the selection in the earlier stages; but they have taken up that question now, and the breed which they have gone in for primarily for this purpose, the Hariana or the Hissar, as they call it, certainly possesses considerable milking qualities. We are testing some of them now on behalf of the Punjab Government at the farm. We purchased 24 of their cows and we are getting most excellent results. Some of them give quite good yields of milk.

A.16. Is it the case that whereas it is difficult to produce a dual purpose animal designed to produce milk and meat, a dual purpose animal to produce milk and working males is not difficult to come by?—That is my opinion. The best draught bullock in Sweden, for instance, is the Holstein. The whole of South Sweden is cultivated with the Holstein bullock.

A.17. The Commission notes what you say on page 9 with regard to the class for instruction of officers in the Co-operative Departments of all the Provincial Governments and Indian States, and also what you say on page 10 in the matter of the Creamery at Anand in Gujarat. You are very anxious to keep that Creamery in your hands?—I am.

A.18. On page 10, you say "Within the last 20 years India has lost the valuable butter export trade to the Far East because of the inferior quality of her butter, due to lack of technical knowledge of methods of manufacture." Can you give us the facts about that?—I have not got the export figures, but up to practically 1913, there was a large export trade done between this country and Ceylon, Penang, Singapore, right round as far as Honkong, Saigon, Bangkok, and all those parts. That trade, I am told by the butter merchants interested in it, has been completely lost. I was in Rangoon sometime ago, and when I saw some of the butter merchants there about it they told me that they were so sick of the quality of butter received from India, that they had given it up entirely in favour of Australian butter. In Rangoon they said that although the Indian butter was better for them because of its higher melting point, the quality was so variable and so bad that they could not sell it alongside the Australian tinned butter.

A.19. *Mr. Calvert:* Have you any idea of the volume of that trade?—I have not got the figures as to the volume.

A.20. *The Chairman:* The figures of export for the last 12 years or so do not appear to support the view that there has been a decline?—They would not, because the War came in, and all the butter that could be got from India was sent to the seat of War. The organisation that I was in charge of was sending 11¼ tons of butter a day for more than two years. We practically bought the whole of the milk in Gujarat in those days. It was before that that they had this export trade.

A.21. So that the figures between 1918 and 1925 do not show the decline?—No, they would not.

A.22. Before we go on any further with your note of evidence, I should like to ask you whether you support the opinion put forward to the Commission by Mr. Bruen, that the fact that the she-buffalo is the principal milk-producing animal of such a large part of India, is one of the principal obstacles to the improvement of the cow as a milk-producing animal. Perhaps you heard Mr. Bruen's evidence?—I heard his evidence.

A.23. What have you to say about that?—I do not think it is putting it in the proper way to say that the buffalo is a menace to the improvement of the cow. The buffalo is there because of the poor quality of the cow, and I think that the improvement of the cow will gradually eliminate the buffalo. I have been told that that has been the case in Italy, particularly, and in some of the Balkan States. I met the Chief of the Dairy Division of the Italian Government this year, and he told me that because the buffalo was a poorer animal for beef it had been gradually eliminated, as they produced better milkers amongst cows, and I think the same thing will take place here. The cow generally in India gives no milk and therefore the people have to keep the buffalo.

A.24. *Mr. Calvert:* What is the draught animal in those countries, the horse or the ox?—In Italy largely the ox.

A.25. *The Chairman:* The point being, I take it, that you have got to have the bullock to do the work, you have got to have the cow in order to produce the bullock, and if the cow can also produce the milk, then you can do without the buffalo?—Yes. I say the cow can produce milk and ought to; you cannot work the cow.

A.26. So that the order of effort should be to improve the cow first, and you think then she will displace the buffalo?—Yes.

A.27. How about the question of early sexual maturity? Has any work been done on that question?—Early general maturity means early sexual maturity. The age of sexual maturity depends on the degree of development of the animal. If you have better breeding and better feeding, you will get earlier general maturity, and with it sexual maturity.

A.28. Is it the case that cows in India do not, as a general rule, throw their first calf until their sixth year?—It is very difficult to state a figure; it is certainly coming near to that if you take the general average. The cattle on the Government farms throw their first calf nearer the third year, showing that what I say is correct.

A.29. *Sir Henry Lawrence:* You accept it in the villages as nearer six years?—I should say so.

A.30. *The Chairman:* It is a question of nutrition?—It is a question of nutrition and breeding. There is no selection in the villages. The capacity of an animal to make good use of nutrition depends upon the way it is bred.

A.31. One does not usually associate high breeding with fecundity?—Well, we have never come anywhere near to the high breeding in Europe.

A.32. Then I should like at this stage to ask you for your opinion about the Military half-breed dairy farms?—I was employed in the Military dairy farms for 15 years; it was at my suggestion that the Military authorities adopted this system, and naturally I support it.

A.33. The half-breed system?—Yes. I believe myself that the Military dairy farms in introducing foreign blood did exactly the right thing from their point of view. There is no way or method that I know by which they could have got milk at the price at which they obtain it now from the half-breds. The Military dairy farms organisation was formed and exists for a specific purpose, that is, primarily, to supply the British troops and Indian station hospitals with pure and safe produce, and to get that at the lowest possible figure there is no doubt that they have to employ foreign blood.

A.34. Is it your view that they should continue to employ foreign blood?—It is, as long as their purpose remains as it is now. That is the *raison d'être* of the Military farms.

A.35. It is a question of cost?—It is for entirely economic reasons, as everything connected with cattle-breeding should be.

A.36. Have you measured the advisability of sacrificing economic efficiency in the Military dairy farms and using the agency of the farms for the improvement of indigenous breeds?—I asked at one period of my career in this department that the whole of the Military farms should be handed over to the Civil Department. The then Agricultural Adviser strongly supported the idea, but they were not given to us. At the same time, if we were to use the Military farms for that purpose we should have to alter the system of breeding altogether. I do not believe in the introduction of foreign blood into India for the general improvement of village cattle under existing conditions.

A.37. Second and third crosses are disappointing, are they not?—You will see some of them this afternoon. In a climate like this the second cross, that is, the three-quarters Ayrshire, is fairly good. The seven-eighths are more weedy. The three-quarter is not nearly so good as the half-bred; the seven-eighth is worse. The F. 2 is useless. We bred about 140 of them before the Civil Department took it over, and I think we got about five good cows out of the lot.

A.38. So that although the Military dairy farms are carrying out their primary function very efficiently, they are making no contribution towards the improvement of the indigenous breeds in India?—No; it is not their function.

A.39. Is it your view that these farms should be handed over by the Military to the Civil Department?—I think, if the Government of India could find the extra cost, it would be a good thing for the country.

A.40. How about the milk for the troops?—If they were taken over for that purpose, whatever department took them over would have to guarantee the milk for the troops. It would cost considerably more money in the earlier stages.

A.41. *Sir Henry Lawrence:* Why more money?—Because you would have to revert to a system of using Indian cattle. The present system of the Military dairy farms from a breeding point of view leads nowhere. You would have to build up indigenous herds at each centre. It would cost a great deal of money to do that, but it would be worth it.

A.42. *The Chairman:* You say it would cost a great deal of money; have you any idea how much?—Without going into the details I cannot answer. There are 34 of these farms, and they differ in every possible way.

A.43. I observe on page 11 you think that there is ample scope for the Veterinary Services in the prevention and cure of animal diseases?—Yes, the prevention and cure of animal diseases I consider to be their function.

A.44. Do you attach importance to breeding and heredity in relation to resistance to disease?—Yes, it is a factor undoubtedly.

A.45. Have you anything other than that which you have set down in your note that you wish to say about the Veterinary Services or about Muktesar?—No; generally speaking I have found the Veterinary Services very ready to co-operate so far as they possibly can. My experience, of course, has been more with the Army Veterinary Department, as I was much longer in the Military Department than I have been in this department, and we found them exceedingly useful in their own sphere.

A.46. What about Muktesar?—Muktesar has given me a great deal of assistance here. They also carried out the simultaneous inoculation for eight years of my service in the Military dairy farms with extraordinary success. We simultaneously inoculated between 1912 and 1916 practically the whole of the animals under my charge in the Southern District of the Military dairy farms. This was done by Muktesar, with practically no loss. Since then there has been practically no rinderpest and no losses from rinderpest in that area.

A.47. *Mr. Calvert:* What is wrong with Hissar?—I do not think there is anything wrong with it.

A.48. Why do you say you would rather take it away from the Veterinary Department? It has been under veterinary control for many years?—I consider the officer in charge of Hissar is probably one of the best farmers and one of the best stock breeders we have in this country. Apart from being a veterinary officer he is a trained and experienced farmer, and a skilled breeder. His work at Hissar is beyond praise; there is nothing wrong with it.

A.49. Do you think it is impossible to have other veterinary officers of the same type?—I think it would be a great pity, in view of the extraordinary need for skilled veterinary men, to turn these men away from the prevention and cure of animal disease. The country cannot afford it.

A.50. *The Chairman:* Do you think yourself that the time has come for an All-India Act dealing with epidemic animal diseases?—Do you mean the restricting of the movement of animals?

A.51. I do?—No.

A.52. Why?—I do not think it could be given effect to. You would have to increase the Veterinary Service to a much greater extent, and that would take time. It would have to be extended and very much more spread over the country, to do anything like that with efficiency. I speak as a layman in regard to that.

A.53. Do you wish to add anything to what you say on page 11 as to the advisability of the formation of a Central Cattle Bureau according to the recommendation of the Board of Agriculture?—Yes, I believe that that Central Bureau would do very good work; but I do not think that such a bureau can take the place of a general central organisation for the guidance and co-ordination of agricultural effort in the country. The Cattle Bureau will perform a specific work if it gets the necessary staff; it has not been provided with it yet.

A.54. I grasp your plan for the organisation of research work and subsequent breeding experiments. Have you worked out in detail how you propose to get down to the cultivator?—Do you refer to dairying research or cattle-breeding?

A.55. In regard to dairying first?—We have first of all to discover how and under what conditions we have to carry out these various operations. As soon as we are able to say definitely how that is to be done and we get the results of our research work, I should be greatly in favour of getting to the cultivator through the agency of the Co-operative Department. I believe that this particular industry, the manufacture of milk products, is specially suited for being carried out on co-operative principles. That was the very reason why I started this class for co-operative officers to get into touch with these men to find out what their ideas were and how much we could assist them. In my opinion in this country if industries of this sort are started by private enterprise the real producer of the milk will not get a proper share of the profit. In practically every country in the world where they have made a success of dairying they have taken up co-operation for the factory part of the work. It has been particularly suitable.

A.56. Have you personal experience of producers' co-operative organisations in this country?—No, I have very little experience in this country. I have experience of it in some other countries.

A.57. But not in this country?—No.

A.58. Have you formed any view as to the soundness of the co-operative societies in this country?—I have come into touch with very few of them. The only ones I know intimately are the Calcutta Co-operative Societies Milk Union; I regard it as a sound and very well-managed concern. They are doing wonderful work in Bengal at the present time. I have advised them ever since I came into this position.

A.59. Where you can establish co-operative dairying, of course you would at the same time establish your machinery for the improvement of breeds?—I should hope so.

A.60. Now think for a moment of villages where dairying would not be taken up. How do you propose in areas of that nature to get down to the villagers and to show them how to improve their working cattle?—The first thing is to supply them with a bull or bulls, and to see that the other males in the village are castrated. That is the first thing that has got to be done, but before we can do that we have got to build up a pedigree. If you will pardon my saying so, I do not think we can worry about crossing the bridge before we reach the stream. The first thing we have got to do in this country is to get pedigree. I have got animals for Government which were supposed to be pure; we sent them long distances at great cost; they were beautiful animals to look at. We made every enquiry we could about their ancestry, but when they started work they produced a collection of weeds. That is happening all over the country. It is no use distributing bulls until they have some power of handing on the qualities they are supposed to possess.

A.61. I quite agree if I were in your shoes I should not worry about crossing the bridge yet; but from our point of view this question of getting down to the cultivator is of such interest and general application that we like to ask witnesses if they have thought the matter out?—There are two or three agencies which you could employ. Co-operative societies would be a very good thing. The bulls distributed in the Punjab are looked after as far as their maintenance and health are concerned, by the Veterinary Department who have a staff large enough to deal with it; that is necessary too.

A.62. You think that is a good scheme?—In the Punjab it works very well. Any agency that will look after the bull, see that the use of other bulls is prohibited, and more or less keep a record of the servings accurately, is good enough. You may use the panchayat or the co-operative society, or you may use the Government of India Department.

A.63. You do not think that by employing the Veterinary Service in that direction you would distract their attention from disease problems?—I think the Veterinary Department could do it quite well, but at the same time it must be borne in mind that if you give them a great deal of that to do, they cannot do the other. The efficiency in that case would depend upon the quality and quantity of the staff they have. I do not think it is of any importance what agency does it; the point is that it has got to be done.

A.64. I think the difficulty is the vast area and the enormous number of villages?—That, of course, is a question of ways and means. I do not think there is any difficulty underlying the principles applicable. The greatest difficulty now is to get the cattle.

A.65. Have you formed any idea as to how long it would take you, given the means that you require, to evolve on pedigree lines?—I should think you would effect a distinct improvement on the third generation and even the second would be better than what we have now. The first is selection, the second is breeding by selection, and the third goes on accumulating the benefit. The effect of all this is cumulative from every point of view.

A.66. Are you satisfied with the facilities for teaching dairying at the Institute?—No, I am not satisfied.

A.67. Do you wish to add anything to your note in that respect?—I think it should be considerably extended, the staff should be increased and the students' hostel accommodation especially should be increased. We had a great many more applicants for this Diploma class that we teach than we were able to take in both cases. I think from the dairying point of view, unless we can turn out men of the practical type that we are attempting here to turn out, there is a very little hope for the dairying industry. The people who now run it have very little knowledge of the technique of the subject.

A.68. Do you keep in touch with your Degree and Diploma men?—I have only passed out one class of Diploma men; I am in touch with all of them. It is not a difficult matter at present.

A.69. Do they come from a wide area of the country?—They come from all over India. The present class is the same. We made our selections purposely in that way. The first time we took one-fourth of the number of applicants, and this year we took about a third. We took them from all over India, not only from a geographical point of view, but from different castes as well.

A.70. Accurate records of their careers will be very interesting in a few years' time, will they not?—Yes. We are not keeping official records, but we could easily do so.

A.71. Following the order of your note, I gather that you have little hope of making scientific modern dairying an economic proposition until reasonable standards of purity and hygiene are insisted upon in the large consuming centres?—That is so.

A.72. Are you thinking of local Acts to enforce standards of that nature, or have you in mind an All-India Public Health Act?—I do not think it matters whether it is All-India or Provincial. As a matter of fact in the larger centres to-day they have got statutes having the force of law which would adequately protect the dairy industry if they were enforced. In Bombay, Calcutta and Patna, I myself was called upon to advise with regard to the drawing up of these Acts, and the standard there adopted, which has now the force of law, would be all right if it were enforced; but I venture to say that in these three towns the milk sold is so bad that it can hardly be described. Mr. Bruen told you, I think, that you can go to a milk vendor in Bombay and he will say, "you can have pure milk or any grade you like below that", and he adds the water. I quite agree with Mr. Bruen. It is contrary to law in Bombay to adulterate milk, but public opinion has not got to the point at which this law is enforced. It is I believe improving.

A.73. I gather from your note that you find provincial officers very ready as a rule to co-operate with you?—Yes, we keep in touch with all the provincial cattle-breeding officers, and where there is no specialist cattle-breeding officer we have been in touch with the Director of Agriculture.

A.74. Do you think provincial cattle-breeding officers are in touch with the work of cattle-breeding officers in other Provinces as well as with your work?—I am afraid they are not. There is no means. That is one reason why the Board of Agriculture pressed the establishment of the Central Cattle Bureau so that there would be a central way of their coming together and each finding out what the other was doing. Most of the cattle-breeding officers and directors of farms write to this office and keep in touch with this office for technical information regarding dairying matters more than cattle-breeding.

A.75. It is no part of your function to correlate the work as between Province and Province?—No, not to my knowledge. It will be part of the function of the Central Cattle Bureau when it is organised.

A.76. What dairying and cattle improvement journals have you in India?—None.

A.77. Is there room for a journal of that sort?—I think there is. I believe Dr. Clouston has proposed the establishment of such a journal.

A.78. In the meantime you have occasional articles in other journals?—We have occasional articles in the *Indian Agricultural Journal*, when we have time to write them.

A.79. *Sir James MacKenna:* I see that in your memorandum you lay great emphasis on the retention of the Anand Creamery?—Yes.

A.80. Do you not think it would be better to take the opportunity of starting a new model factory instead of retaining Anand?—No. The Military dairies took two years to get a suitable site in days when the Government of India had control of the land there. Now the land and all that sort of thing is controlled by the Provincial Government. I think it would be impossible for us to get any site anything like as suitable as Anand for the establishment of an experimental and educational dairy factory. Anand is situated at the junction of four railway lines, right against the station; it has got a first class water-supply, and that is very valuable. It is very difficult to get a good water-supply for a creamery; a creamery requires a great deal of water.

A.81. The future of this creamery is somewhat in the balance?—Yes.

A.82. Do you think that the maintenance of this creamery is a matter of such importance that the Royal Commission should make an *interim* recommendation apart from their final recommendations?—I would greatly appreciate it. I have suggested that the Commission should send some one to see the district and see its extraordinary possibilities from a dairying point of view. It is the one real dairying district in India.

A.83. I see from page 10 its position is precarious?—I have been told so.

A.84. You recommend that the Royal Commission should, if possible, depute a section if not the whole Commission to visit it?—It would be a very good thing. I think they would agree with me when they see the place and conditions.

A.85. What special lines of research and experiment have you been able to take up since you received this appointment, on the various farms you have?—We have taken up very little of experimental work. All that we have taken up with regard to cattle-breeding is the demonstration of dual purpose animals, like the Hariana. We have also carried on cross-breeding work here with a view to demonstrating milk production. In regard to investigation into dairying problems, we have done some original work here in connection with the neutralisation of sour cream by lime, and the sterilisation of milk, one or two minor points of that type; things that could be taken up here were done by the dairy staff with the assistance of Mr. Warth. Mr. Warth, who happens to have his laboratory there, has co-operated loyally with us. We have been able to do one or two little things like that, but generally speaking we have not yet tackled any of the major problems.

A.86. What happened during the gap of three years between your appointment as Imperial Dairy Expert and the taking over of your farms?—Nothing happened. We had no funds and no facilities to do anything. I used to write to Mr. Milligan almost every day for three years and then we got these three Military dairy farms.

A.87. How did you keep yourself employed?—By giving advice and drawing up plans for people, things like that; we did what we could; I think the time was wasted.

A.88. So that you really lost three years?—Yes.

A.89. What do you think is the main cause of the inferiority of cattle in this country? Is it due to lack of means, or lack of care, on the part of owners?—I think it is lack of knowledge. The breeding classes are probably the most ignorant and prejudiced people in the whole country. They had vast areas to roam over in the old days, and they are now restricted, with the result that they have turned into professional fodder thieves. I think you will agree with me that in Northern Gujarat they certainly are professional fodder thieves. We want to get cattle-breeding into the hands of a better class of people. That is why I stress the point that the cultivator must be the breeder.

A.90. *Dr. Hyder:* Where were these vast areas of which you are speaking?—There were vast areas in the Punjab; there are now vast areas in Bihar and Orissa, and North Arcot (Madras).

A.91. Where are these areas in the Punjab?—The present canal areas were all given over to cattle-breeding. The Sutlej Canal has been brought into a district which was occupied by cattle-breeders. In Montgomery there was nothing but cattle-breeding; Lyallpur district was the same.

A.92. My point is that at present these areas do not exist in the Punjab; the land is under the plough?—Certainly it is, but they were grazing areas before the canals were excavated. The canals have converted these areas into agricultural lands now. It is the canal which has driven the cattle-breeder into the corner.

A.93. But these jungle cattle-breeders have taken to cultivation?—They are gradually. Attempts are being made to get them to take up land and in some instances they have done so. Generally speaking, I believe the men who were brought in as cultivators were not the jungly cattle-breeders.

A.94. In Bihar you say there are vast areas?—There are vast areas in the hill tracts of Bihar now that are given over to cattle-breeding. Then in North Arcot there are thousands of acres of it, covered with cattle, the worst weeds you have ever seen. There is no system whatever in the breeding.

A.95. *Sir James MacKenna:* With reference to your answer to the Chairman as to All-India legislation on cattle diseases, apart from the necessity for increasing the veterinary staff to enforce such legislation, do you consider a considerable strengthening of the Veterinary Department is desirable in the interests of agriculture?—It is certainly.

A.96. Do you think that if by the strengthening of your Veterinary Departments you can save the lives of 4,000 animals, that would be equivalent to an enormous increase?—Yes, that is so; I believe it would be entirely economic to increase the veterinary staff enormously.

A.97. Are there any points on which you consider an early expression of opinion of the Commission, in connection with this new branch of agricultural research is necessary in order to prevent the stopping of important work?—I think it is of vital importance to the Central Department of Agriculture that something should be done to modify the existing Devolution Rules. I believe that the lack of funds from which we are suffering and the restriction of our work is largely due to the fact that under the Devolution Rules there is no real place for a Central Department of Agriculture. It is distinctly stated in those rules that Agriculture, including research, is a Transferred subject, and consequently the Government of India rightly feel that they cannot co-operate with the Provinces if it costs any money.

A.98. Such co-operation is of course absolutely essential for the development of your work?—Yes, undoubtedly. This co-operative class of mine that I was so keen on has been stopped solely on account of that. They say, "Really it is exceeding our powers under the Devolution Rules."

A.99. In these one or two matters, would an *interim* report or expression of opinion of this Commission be of the very greatest help?—It would.

A.100. Both to you and probably to the Government of India?—I think it would.

A.101. And to Local Governments too, probably?—Yes.

A.102. There is no lack of will on the part of Local Governments. In point of fact the correspondence shows there is a desire on the part of Local Governments to have the advantage of this centralised instruction or assistance and the letter attached to your memorandum has probably been written with the authority of the responsible Minister?—I think so.

A.103. So that it looks as if it were a point on which, if this Commission could give an expression of opinion, there would be unanimity of acceptance?—Yes.

A.104. *Professor Gangulee:* In reply to Sir James MacKenna you stated that you were appointed in 1920 and that for three years you had practically nothing to do?—I did not say that. I said that I did not have the legitimate work that I should have had to do. I occupied my time as well as I could.

A.105. And during that period your expenditure was something like Rs. 98,000?—It was Rs. 26,000 in 1921; Rs. 33,000 in 1922; and Rs. 39,000 in 1923. That is, about Rs. 98,000.

A.106. Now with regard to your educational system, I see that you have got something like a graduated system of dairy education. In the first place, you have got the post-graduate arrangement; then the Diploma arrangement and the short course arrangement. The Diploma course is for two years?—Yes.

A.107. Could you kindly give us an idea of the syllabus?—I have given every member a copy of the syllabus.

A.108. In the short course you have 74 students?—We had, during the last two years.

A.109. How are the students utilising their knowledge?—Nearly all of these men were officers in the various departments of agriculture, with the exception of a few students engaged in the dairy business. They were nearly all men sent to us by the various agricultural departments throughout India, and they returned to their posts after they had finished.

A.110. So that there is that degree of co-operation between yourselves and the Provinces?—Yes.

A.111. On page 6 you have answered the point about research work. You state here that little or nothing has been done to solve the many pressing problems affecting the dairying and cattle-breeding industry. Are you referring to any fundamental research?—I have specified some of the lines of research that, I think, are most generally needed. I would class these as fundamental.

A.112. And you have not been able to undertake any of these researches?—No.

A.113. You lay a great deal of emphasis on the dairy industry. Are you of opinion that the dairy industry in India has a great future before it?—I am.

A.114. You say, in reply to a letter from the Honorary Secretary of the All-India Cow Conference, that even the cattle-breeding and dairy industry in India have made great strides since 1914. Can you tell us in what particular direction these great strides have been made?—Principally in the establishment of this place here and in the appointment of Cattle-Breeding Experts by almost all the Governments in India. There was nothing done before that. These two things I consider were the first real movement, and they are of great importance.

A.115. Do you agree with me that the dairy industry depends to a great extent on the climate, the soil, the water and fodder-supply of certain regions?—All these are factors.

A.116. Have you undertaken a survey showing what may be called the potential dairy areas in India?—No.

A.117. Do you not think it would be useful?—It would be, but it is not nearly so important as the improvement of the cattle and the investigation of the dairy problems. It is of no use my being able to say that this particular place is fitted for the dairy industry until I can tell the people how to conduct it.

A.118. Would it not be useful if you could define a dairy belt in India?—There is no dairy belt.

A.119. The dairy areas?—I do not think you can classify it. The whole country must be dairying because the whole country must be cattle-breeding. You cannot work India without cattle; you cannot get a bullock without a cow and therefore the cattle problem arises all the time.

A.120. Do you not think that geographical limitations are a great handicap?—They are a factor, but they are not the primary factor.

A.121. With regard to the dairy industry, you recognise that a scheme for milk-recording is fundamentally necessary?—Yes, it is.

A.122. Have you adopted any such scheme?—Yes, we have. Records on these farms have been kept carefully of every drop of milk produced since they were started. On this farm, and in fact all the Government farms, there is a record kept of every drop of milk since it was started. That applies to Pusa.

A.123. Is there any recording of milk among the cultivators?—Generally speaking, none.

A.124. *Dr. Hyder:* Have you got any figures of the average cost of such a scheme of milk recording and testing?—No, I could not give you the cost of anything like that; our figures are too much intertwined. There is one man who does this work, and of course he does a great many other things as well.

A.125. Are you aware of the cost of such schemes in other parts of the world?—Well, generally speaking.

A.126. Is the cost high or low?—Low. A great part of the work is done by the staff that would in any case be there. The authenticating of the records is the thing that costs money. That is generally done by central bodies with Government assistance; in fact, it is done all over the world in this way. That, I think, should be one of the primary functions of this Cattle Bureau.

A.127. *Professor Gangulee:* On page 8, you refer to these dairy products as being a village industry. You do not conceive of a time when the dairy industry could be run on a factory scale?—I do.

A.128. Do you think it could be a village industry run on factory lines?—Well, we could have a factory where we have collected milk. You can make cheese in Scotland, where you have got large enough holdings to provide a sufficient supply, but you cannot make cheese in Ireland on the farm; you have to have the factory system, and the same applies to Holland and Denmark which have a village factory industry. In fact, I go further and say that it cannot be economically worked upon any other basis. All that would be necessary would be your plant and buildings.

A.129. On page 8 you say, "The building up of pedigree herds in India must be a losing business for many years to come and therefore it can only be done by the State." What breeds in your opinion should form the foundations upon which dairy herds could be built?—The Scindi, the Thar Parkar, the Hariana, the Ongole of Southern India, the Amrit Mahal (I should get milk into the Amrit Mahal), the Dangi as it is called. These are probably the most pure and the breeds from which we are most likely to get good results at an early date.

A.130. Have you got any definite data to show that these breeds that you have just mentioned should be the foundations upon which dairy herds could be built?—I have definite data of them all except the Amrit Mahal.

A.131. What was the basis of your selection of stock?—The basis of selection was the milking test *plus* form. Every animal I bought I milked for two days; in fact I have never bought a cow in this country without having her milked in my presence, and I weighed the milk myself.

A.132. *Mr. Calvert:* Do you omit the Sahiwal breed?—Yes, I omitted it advisedly. It is not a dual purpose animal; it is not good for draught in my opinion.

A.133. Would you include the Dhunni?—It will make a very good foundation. It has no milk, but in that respect it is like the Amrit Mahal. It is a very distinct breed, and it is a very good one.

A.134. *Professor Gangulee:* So milking quality is the basis of your selection?—No, milking quality *plus* draught quality, or one can put it the other way round. I say they have got to go hand in hand.

A.135. There are two qualities certainly, milking and draught?—Yes.

A.136. In milking quality, do you go by the percentage of butter fat?—Yes.

A.137. With regard to the distribution and control of pedigree bulls, do you think the registration and inspection of breeding stock would be required for the improvement of the livestock of the country?—Registration and inspection of pedigree herds will certainly be required.

A.138. The Government of North Ireland have introduced a system of compulsory registration?—They have.

A.139. Do you think the time has come for this country to adopt that measure?—No, not nearly come.

A.140. With regard to castration of unfit males on an organised scale, would you make it compulsory?—That again is a veterinary question. It would be a very good thing if you could do it, but it is no use making anything like that compulsory until you have a fair chance of enforcing it. I do not think with the present staff and arrangements it could be enforced.

A.141. If you had the staff and the machinery, you would be in favour of it?—Yes.

A.142. You think it is fundamentally necessary?—I think it would be a very good thing.

A.143. With regard to the service bull, have you any scheme by which this service could be made popular?—Give it for nothing, and have no other bulls.

A.144. You would not utilise the Local Boards and District Boards for the purpose, to give it free?—Yes, that is what I mean; give it free, charge nothing, and have no other bulls. There is no doubt as to the popularity of that.

A.145. You will make it popular if you give it free?—Yes.

A.146. *Dr. Hyder:* They are unpopular if you give them free, are they not?—No; where they get them for nothing the bulls which have been distributed by most Governments are very popular. In fact, the tendency in most cases is to give them far too much work.

A.147. *Professor Gangulee:* From your experience of the co-operative organisations in Europe, do you think co-operative organisations could be utilised as a suitable agency for the improvement of livestock in the country?—I do.

A.148. The conditions affecting the dairy and cattle-breeding industry in this country are widely different from those of Europe, are they not?—They are.

A.149. Do you think we could possibly utilise the co-operative organisations in the same way in this country?—I should certainly think so. I see no reason why we should not; human nature is the same throughout; that is the basis of it all.

A.150. *Mr. Calvert:* I am not yet clear in my own mind on this question of the deterioration of cattle. You say that the quality of the cattle of India gets worse from year to year? Do you put that forward as a scientific statement or just a popular opinion?—It must be a matter of opinion.

A.151. I was thinking of the Sind Sagar Doab, where conditions are exactly the same as they were hundreds of years ago, and where the people still live by grazing?—Yes.

A.152. The class of cattle there is very poor?—Yes. There may be areas where the cattle have not deteriorated, but taking the country generally, they have. I have been travelling in this country for 21 years, and I travel about 15,000 miles a year. Since I came to this country, I certainly think, the quality of the cattle has deteriorated. Except in parts of the Punjab, where you have really made an impression with your Hissar bull, you can see in all the villages they are getting worse. I have bought cattle in the Punjab since 1906 up to a year or two ago, and every year, believe me, the cattle at the Amritsar fair are getting worse and worse. Mr. Keventer told me in Poona last week that he does not go near the Punjab now. His buyer used to visit the Amritsar fair regularly in October for many years, and every year he now goes to another part. Mr. Keventer says exactly the same thing, that the quality of the animal he can get to-day is nothing like so good as the quality of those he got 25 years ago. I have spoken to Forest Officers and people in various parts of the country, and particularly the Forest Officer in Dharwar who has been there many years. The zamindar of Kangundi, who is one of the largest cattle-breeders in North Arcot, is also of the same opinion. All of them support my statement.

A.153. May not that deterioration of the cattle at the Amritsar fair be due to the fact that the people are now so prosperous that they can afford to keep their best cattle?—That may be a factor. The fair that is held 14 miles south of Rohtak I have attended twice with an interval of 16 years, and I am satisfied that there also there was a great deterioration. I bought a number of cattle on both occasions.

A.154. Is that Jahazgarh?—Yes, it is one of the biggest cattle fairs in India.

A.155. You say the people of India will not put the female of the ox to the plough?—Yes.

A.156. Is that general throughout India?—Absolutely.

A.157. It is not universal but it is general?—It is nearly universal.

A.158. Plough cattle are exempt from attachment for debt. Have you heard of cows being utilised for the plough to secure that exemption?—No.

A.159. I gather you think that at present there is no hope that private enterprise will build up pedigree herds?—No.

A.160. Are you in a position to amplify your explanation of the objections raised to the continuation of your courses here at Bangalore for co-operative students?—No, I have never been told the reasons. All that I know is the letter which you have.

A.161. When you speak of dairying, are you thinking of the keeping of cattle in order to sell their products, or for home consumption?—For both.

A.162. But they are two very different problems, are they not?—There are many variations of the dairying industry. The production and handling of milk is dairying. What you do with it afterwards is of course only one of the many details of the business.

A.163. I am thinking of the difficulty in the way of bringing into being anything approaching efficient dairying in India. You mentioned in your note the religious objections to getting rid of inferior cattle. Does not that objection also make it difficult to put into the herds better and better cows as they reach maturity?—No.

A.164. If you put a better cow in, it must displace the inferior animal?—Yes.

A. 165. But if you cannot get rid of the inferior cow, you are in a difficulty?—You can in course of time. The inferior cow has got to die. What you have to do is to look to the future and see that everything that is coming on is better. There is no other way. There is no objection to doing it in that manner; it has got to be gradual.

A.166. That difficulty of the elimination of the poorer animal is a very big obstacle in the way of introducing better blood, is it not?—It is, if you want immediate results, but it is not in the long run. We are not in a position to give immediate results anyhow, generally speaking.

A.167. Have you any experience at all of milk recording by private bodies in India?—Very little. Mr. Keventer does a little of it, and also one or two private owners. One or two people do it, but it is very little.

Mr. W. Smith.

A.168. Do you think it is within the capacity of the ordinary cultivating class?—With a little organisation, it is.

A.169. You have not seen the milk-recording societies started by your students in the Punjab?—I went round with Mr. Strickland for two or three days. He talked with the people, and he seemed to think that it was quite a practicable proposal.

A.170. It is promising?—Yes.

A.171. *Dr. Hyder:* Does Mr. Keventer keep buffaloes or cows?—He keeps both. He keeps cows entirely at Simla, and he has a number of buffaloes at Aligarh. He buys all the milk for butter-making. He produces butter, but he buys the milk for that.

A.172. *Mr. Calvert:* With regard to this question of the drain of good milking cows to cities, do you think that is a considerable drain?—It is; it is a considerable drain, because of the fact that the number of real good milking cows in the country is so small. They only buy the best in the cities.

A.173. Do they take the best?—They do, undoubtedly.

A.174. Then they are lost for breeding purposes?—They do not breed any more.

A.175. I gather that by dual purposes you mean a fair milker and a fair draught animal?—That is so.

A.176. Of what standard as a milker are you thinking?—I should aim at a standard to commence with of 3,000 lbs. per year for a milker.

A.177. What about the draught animal?—It must be a suitable plough bullock for the district. I cannot define it more clearly than that.

A.178. In your note you say there is a great deal of inefficiency of cultivation owing to the inefficiency of the bullock?—Yes.

A. 179. Does that apply to places like the Punjab?—To parts of the Punjab it does, and to parts it does not. Round our place at Karnal the people tell me that the bullocks cannot pull the improved plough which we want them to use. Our bullocks can pull the improved plough without the slightest trouble. It applies equally to the Punjab.

A.180. Then you think you can get the milk into the Hariana, but cannot get the draught into the Sahiwal?—It is not necessary, because in the Hariana breed you have probably got a more suitable and more likely animal to work with. The Hariana, which we have, are milking wonderfully. Cows that have never been recorded before are now giving up to 3,000 or 4,000 lbs. The Hariana is a really good dual purpose animal.

A.181. The Hariana was going too much for draught?—Up to a year or two ago they paid no attention to milk.

A.182. They were breeding for the Artillery?—They were breeding for the urgent demand and they had not the staff. I believe they are getting the staff now.

A.183. They had to breed for the bullock batteries?—They did. They bred for the Army many years.

A.184. Do you think that there is much advantage to be gained from selecting suitable young stock from villages and sending them to a Government farm to be looked after in the early years?—No, I do not think it is of much use. I think it would be far better to confine one's efforts to selecting and then breeding carefully to produce pedigree.

A.185. You have got a farm at Hissar which is the biggest in India, but the number of bulls which it can turn out every year is strictly limited?—Yes, but it is to be very rapidly increased.

A.186. Have you tried selecting young animals from the villages and taking them to the farm to be well looked after?—It is not nearly so good as what they are doing at Hissar with their own cattle. They have generations of pedigree and the animals produced will be sure to be what is wanted. I have done a great deal of it myself.

Mr. W. Smith.

A.187. *Sir Henry Lawrence:* What are the figures of bulls turned out at Hissar?—I do not know.

Mr. Calvert: They have been turning out 300 a year, but now they are increasing that. They hope to double it shortly.

A.188. *Sir Henry Lawrence:* For your ultimate ideal of cattle in India, you would have only pedigree bulls from Government farms or from known stock?—Yes.

A.189. Gradually eliminating the whole of the scrub bulls we have got?—There is no other way to get the result.

A.190. *Mr. Kamat:* You have told the Commission that in Great Britain private enterprise was able to raise pedigree herds, and yet you say that in India it is an impossibility?—Yes.

A.191. You have also stated on page 8 of your memorandum that cattle-breeding farms in India cannot be expected to pay their way for many years to come?—Yes.

A.192. You stand by that?—I do.

A.193. I want to know how you reconcile that with your statement on page 9 with reference to the cultivator that "if he uses the right breeds and practises the correct methods, cattle-rearing and the growing and conserving of fodder crops for this purpose as a regular part of his agricultural operations will be profitable." Apparently it is not profitable for Government with all their resources and it is not profitable for the big landholder. How can it be made profitable to the small cultivator?—If you read on to the next paragraph you will see that I distinctly say that this cannot be done by the cultivator until we give him pedigree bulls. It is the evolution of the pedigree that is going to cost the money. That is what is not profitable.

A.194. The bigger landowner can get the predigree bull?—No, I have said he cannot; it must be done by the State.

A.195. The State can get the pedigree bulls?—Yes, if it pays the money, but it must be unprofitable commercially.

A.196. And yet you say that Government cattle farms cannot pay their way?—Certainly not, as long as they are making the pedigree.

A.197. So that that is not the chief factor?—Yes, it is the one and only factor.

A.198. But I understand you to say it is not profitable for the State or for the big landowner, and yet it is likely to be profitable for the cultivator?—It will be profitable for the cultivator when we give him the pedigree. It is the manufacture of the pedigree that will be unprofitable.

A.199. Can you give me a rough idea how long it takes for the cultivator to sell his young stock, and what would be the cost of maintenance of his animal, even if you gave him the pedigree bull. Will it take three years or four years?—It all depends. In some parts of the country they sell their young stock when they are weaned. In others they rear them. In some parts they break them in as bullocks and sell them.

A.200. Till then he has to maintain his cow?—Yes, and its calf.

A.201. It is not an economic proposition; he loses every month?—Not necessarily. If he has the proper class of animal bred from a pedigree bull he will not lose; it will be a profitable business.

A.202. From the commencement?—From the commencement of the time that he gets a proper type of pedigree bull.

A.203. From the very commencement you say it will be profitable for him; that is to say, the milk yield has a value which covers his expenses?—That, of course, depends on the class of cow he is using.

A.204. Given a pedigree and the class of cow, the yield of milk covers his daily or monthly expenses. Is that so?—Well, that ought to be our aim. At the present time it does not.

A.205. I am asking you, 'could you make that so'?—I can.

A.206. If it can be made a self-supporting business given these two things, I wonder why Government cattle farms could not also be made self-supporting?—They would, when they have got a pedigree. It is the elimination of the unfit, in order to establish a pedigree, that is going to cost the money. What are you going to do with the rejected? You start with animals that are selected. You know nothing about them from the breeding point of view. You will probably get five out of seven that are worth keeping. What is to be done with the other two? Who is to bear the loss of those that are of no use? It is the building up of the pedigree that is going to be the expensive thing, and the aim is to produce a pedigree which will make it more profitable for the cultivator.

A.207. *Mr. Calvert:* Have you seen the progress of the cow-breeding colonisation scheme in Montgomery?—I have been there.

A.208. Is it hopeful?—It is hopeful.

A.209. That is where a grant of land is given to the cultivator on condition that he maintains an approved type of cow?—I saw all the cows in the colony with Mr. Strickland, and I think it is a very good thing.

A.210. *Mr. Kamat:* You told us that in this competition of the buffalo against the cow, it is possible that the cow will eventually eliminate the buffalo. Is that right?—Yes.

A.211. How long will it take to evolve a type of cow which will give such milk as will enable her to displace the buffalo?—That depends entirely on the amount of funds and the staff which are allotted for the purpose.

A.212. Given the funds and the staff, how long will it take you to evolve a pedigree breed? Will it take three generations or four generations?—I should think there would be a very marked improvement in 25 years.

A.213. Till then the cow cannot hold her position?—She will gradually make her way. She is here now, and she should be getting better every year.

A.214. You think that the cow can eliminate the buffalo?—I believe it can, and I believe it must.

A.215. Do you think it will take 25 years?—I say it will take longer than 25 years; but there will be a marked improvement in 25 years, provided the staff and the funds allotted are adequate.

A.216. You say that the policy of the Military dairy farms was detrimental to the general interest of cattle-breeding, as it was based purely on the economic principle of getting the highest yield of milk. If this cross-breeding system is inevitable in the case of the Military dairy farms, purely from an economic point of view, will it not also be inevitable for the private cultivator who wants to go in for the dairying business?—I did not say that the policy of the Military dairy farms was detrimental to the general cattle-breeding of the country. In my opinion it has had no effect whatever on it and it has nothing to do with it. It has not affected it, nor is it likely to affect it in any way.

A.217. You do not agree with Mr. Bruen on that point?—I disagree with him most emphatically.

A.218. The prejudice against castration exists only in certain parts of the country. In other parts castration in an approved form is carried on?—Yes, by the Italian method.

A.219. You say the dairying business has a future in India. May I know then why the fate of the Anand Creamery is hanging in the balance? Is it not the fact that Government are trying to close it down because it is not a commercial proposition?—That is so.

A.220. Why is it not a commercial proposition for the Government?—Because it has been established in order to carry on investigation and to teach students. We have the full complement of students just now. There are no dairying educational institutions in the world that I know of that pay their way commercially.

A.221. You say in your memorandum that something could be done with butter-milk as a bye-product of milk?—A bye-product of *ghi.*

A.222. Have you published any bulletin as to what could be done with it?—I have not.

A.223. Government have not yet taken any steps to publish the results of your research?—I cannot tell you what can be done because I have not made any experiments.

A.224. You feel something could be done, but you are not in a position at the present moment to say what could be done?—I am certain it can be done.

A.225. It is a matter of research?—It is a matter of investigation. Conditions with regard to buffalo milk are so different from the conditions with cows' milk in every respect.

A.226. For the present do you know anything more than the layman knows?—No.

A.227. *Mr. Calvert:* Can dairying education of the Bangalore standard be given in any of the provincial agricultural colleges?—Not at present.

A.228. In none of them?—None of them.

A.229. So that if your education in dairying at Bangalore is closed down, there is nothing at present to replace it?—There is nothing.

A.230. *Mr. Kamat:* Do you think the manufacture of condensed milk in this country is a possibility in the near future?—Yes; we made a trial last week; we have the samples here.

A.231. You think it could be done on a commercial scale in various parts of India?—I have been asked by two of the largest provision firms in India, one of them two years ago and one quite lately, to tell them definitely whether they would be safe in investing money in India in a condensed milk plant as they are large importers and they think they can produce it much cheaper in the country. In view of this enquiry we have purchased a plant, but we have never had any funds to work it. We have had just funds enough to pay for the plant.

A.232. No experiments even on a laboratory scale have been done?—No.

A.233. *Sir Henry Lawrence:* As regards the last question, what funds are there at your disposal for your experiments?—We have had none allocated so far specially for experiments. The budget for the working of the dairy has been utilised to do what little we have done.

A.234. How much does it represent?—I shall have to get the figures. Will you permit me to give them to you later? The net sum of course is much smaller than the budget as we return most of the money we get at these farms, but I will give you the gross and net figures later.

A.235. Can you give me any estimate of the total expenditure you would like to make?—The revenue expenditure at the Bangalore, Wellington and Karnal Farms for the year ending March 1926 was 3,15,182 rupees and for the same period the receipts from these farms were 3,13,655 rupees. A detailed note of expenditure and receipts has been handed over to each Member.

A.236. *The Chairman:* The actual net expenditure is not shown?—No. The revenue expenditure generally is less than the receipts. I will send the figures to you in a statement. (Appendix II, page 47).

A.237. *Sir Henry Lawrence:* All told, the Government of India are not spending out of pocket much more than a lakh of rupees a year?—They are not spending anything like that, on revenue expenditure.

A.238. What do you consider the interests of the country in dairying and improvement of cattle are worth?—You could economically spend a crore with really good results. The Irish Free State this year are building a new dairy school at a cost of £49,000 and are allotting £6,000 a year to keep it up, and they have only 3¼ million people.

A.239. So that if the Government of India and the Provincial Governments were to spend some crores of rupees, it would not be money thrown away?—It certainly would not; we have got 170 million cattle in the country.

A.240. *Dr. Hyder:* Do you think one research institute would be able to cope with such a vast number of cattle?—No, I do not.

A.241. *Sir Henry Lawrence:* Would you like to increase the number of institutes throughout India to half a dozen or so?—Half a dozen would certainly not be an unreasonable figure.

A.242. Do you know anything of the progress of building up some half-bred herds in Brazil and Texas, for which Indian bulls were imported?—The best known is Mr. Borden's herd in Texas. He had Gir bulls and the cattle he now has are one-eighth Gir. They show distinctive traces of the Gir head and twisted ear in every case. They are superior to the pure European breeds in this respect that they could go further to water and come back without losing flesh. They are bred for beef entirely.

A.243. When was that experiment made?—It began I think about 20 years ago. I sent Mr. Borden his first bull in 1904. He has an eighth part left in a great many of them, but he cannot get in any more bulls. He tried very hard, but the United States Government absolutely refused to allow him. He said the Gir put on beef better than any.

A.244. Why were they not sent?—The United States Government would not allow them to go in.

A.245. A similar success has been achieved in Brazil?—In Brazil they were largely got for breeding purposes, the pure Nellore. There are two very fine herds in Brazil. We published in the *Agricultural Journal* two photographs we had procured for the purpose. There are some 1,800 head of pure Nellore in Brazil; that is in the herd of one man; it is a private venture. He sells bulls for very high prices. They use Nellore, I believe, mostly in the coffee districts and the planters use the cows for milk.

A.246. I am not quite clear about your views on the question of importing bulls and their effect in this country. You say that the second and third cross, 3/4 and 7/8, are not suitable?—No.

A.247. But the experience in Brazil and Texas is to give a cross in the first generation and then continue with other cross-breds I think?—No, Mr. Borden continued with pure-bred bulls. He used pure Shorthorn and pure Hereford. Mr. Borden is far too clever a man to breed with cross-bred bulls. He uses nothing but the best.

A.243. But then he does not keep on with the Gir bull?—He cannot; he would like to do it very much, but they will not allow him to bring them in. The last lot that arrived for him there were, I believe, slaughtered at Washington.

A.249. Then there is no lesson to be drawn from these Brazil and Texas experiments that is of any value to this country?—No. In Brazil, as far as I know, they have kept the Indian breeds pure. In fact the finest Nellore cattle in the world are undoubtedly found in Cuba and Brazil to-day.

A.250. The losses from rinderpest are very severe in this country?—They are.

A.251. To what extent can it be rightly said that the local cattle are immune from rinderpest?—Some are more immune than others, but all of them, except the hill cattle, have a very high degree of natural immunity.

A.252. But how do you reconcile that with the loss from rinderpest?—If they did not have that degree of natural immunity, the loss would be 90 per cent. Probably it is not more than 25 per cent. In the Military dairies before the days of simultaneous inoculation we never lost more than 30 per cent. In one lot of Aden cows we lost the whole lot; they died like flies; they had no natural immunity.

Mr. W. Smith.

A.253. You mentioned in answer to the Chairman that you regard heredity as one of the important factors in the improvement of cattle?—Yes.

A.254. Is it not the primary factor?—It is.

A.255. I thought you regarded it as one of the minor factors?—Pedigree means that you have the force of heredity.

A.256. *The Chairman:* The witness's point was that heredity is an important factor in resistance to disease?—Yes, it is. That, as proved with the half-breds, is a Mendelian factor. Some of them carry a high degree of immunity to rinderpest, and some of them have no immunity at all.

A.257. *Sir Henry Lawrence:* Amongst the good breeds that can be improved for milk you mentioned the Deccani. I was not quite sure what breed you had in mind. Were you referring to the Krishna Valley cattle?—No. Krishna Valley cattle are the Nellore cattle. I was referring to the Dangi cattle. They are black and white. They breed wonderfully pure. You get them all round Belgaum.

A.258. What do you mean by Deccani?—They are generally called in that district Deccani cattle. They call it Dangi.

A.259. Then, you said that Mr. Keventer was sending milk from Aligarh to Delhi. What distance is it?—It is about 100 miles.

A.260. What do you regard as the best system for the production of milk for Bombay?—Production in the fields in a rural area where you can get all the fodder you need, pasteurisation, and railing it into Bombay. I regard that as the system for all Indian cities.

A.261. Do you know of any particular difficulty in the way of having successful dairies established outside Bombay?—None, except the one great difficulty which strikes at the root of this question of urban milk-supply, the want of protection against impure produce. That is the principal difficulty.

A.262. *Mr. Calvert:* Bad milk drives out good milk?—It is not so much that, but the respectable business man will not invest his money in the dairy industry if he has to compete against every kind of white liquid sold as milk. It is unfair competition and the risk is too great for the capitalist to undertake.

A.263. *Sir Henry Lawrence:* What you draw attention to is the necessity of improving the protection of the purchaser of milk in the cities?—Yes, and of the vendor. The protection of the vendor from the point of view of the dairy trade is really the important thing. The honest vendor now has no chance.

A.264. There are regulations, but they are not enforced?—Yes, standards have been fixed and everything else.

A.265. *Professor Gangulee:* Are they not being enforced in Calcutta now?—Not very well. The Municipality have given half a lakh of rupees to a co-operative society, and that society is going ahead very well because they are selling pure milk, but they complain bitterly of the competition they have to meet.

A.266. Mr. Keventer sells milk in Calcutta and he has good milk?—The quantity of milk he sells is very small. He does not come to the commercial scale. He has the gilt-edged trade which you can get in any community at a very high price.

A.267. *Sir Ganga Ram:* Have you published any pamphlet or book containing the names of the fodders you have experimented on?—I have not experimented on any fodders.

A.268. You say you have experimented on different kinds of fodder?—No, that is Mr. Warth.

A.269. Do the Military Department generally make butter from buffalo milk?—They always make it from buffalo milk.

A.270. What is the difference between buffalo milk and cow's milk?—The proportion of fat in the milk of the class of cows that the Military dairy farms use may be taken as 4·25 per cent on an average; the percentage of fat in the milk of the buffalo is usually 7·75.

A.271. Is there any physical or scientific objection to the male buffalo being used for draught purposes?—The general experience is, he will not work in the heat which is the time when you want him to work. I have tried him myself in farms under my charge.

A.272. Is he used for drawing carts?—He is a bit slow, but the worst objection is that he lies down when it gets a little hot.

A.273. As far as you know there is no religious objection?—None whatever.

A.274. *Dr. Hyder:* You stated that the buffalo will not work in the heat. Do you know the hours of ploughing in different parts of the country? Do they not begin ploughing at 5 in the morning and finish up by 10 A.M. and plough again in the afternoon after the heat has subsided? If that is so, the question of employing the male buffalo in the heat does not arise?—The buffalo is too slow, and the chief thing for the cultivator is speed. He gets the rain, and he has to get on with his cultivation or it is too late.

A.275. Is that so in the Mysore State?—Yes. He ploughs all day round about here in the season.

A.276. *Sir Thomas Middleton:* Can you give us any idea of the number of pedigree bulls now being produced by the different farms in India?—I cannot say.

A.277. Approximately is it 500 or 5,000?—I cannot say.

A.278. Can you tell us how these bulls are tested? I understand they have short pedigree?—Yes.

A.279. How are they tested? Are they tested at all before being sent out?—The test applied is of course the general size, utility and power of movement.

A.280. Is the quality of their progeny followed up by inspecting officers?—In some instances it is, but generally it is not.

A.281. Can you give me any idea at all as to the number of misfits among these bulls that are sent out?—Amongst the bulls sent out from the Punjab farm, which is the biggest, I do not think there are many. They are very careful about sending them out; there is nothing sent out that is not good; they are not sent out until they are mature. Outside the Punjab comparatively few pedigree bulls have been sent out so far.

A.282. Your scheme is to supply Government pedigree bulls for all the cows of India?—Yes, eventually.

A.283. How many pedigree bulls would you want?—A million. You have got 44 million adult cows, and at the rate of 1 bull for every 50 cows, you need a million bulls.

A.284. I do not know whether you have considered any time table for your scheme or whether you have contemplated a process of 20 or 30 years' development?—It is hardly in the nature of a scheme yet so far as I am concerned. I have only put down the ideal that has to be attained. We have not had the temerity to go into a scheme as yet.

A.285. Would you agree with me that to reach that ideal it would take many years?—It certainly would.

A.286. Would it be measured by years or centuries?—By years. It has a cumulative effect, you see. Every bull you get out is good for 50 cows per year. I am thinking of what has been done in Ireland since they started the premium bull system. They have revolutionised the cattle in the south of Ireland in 20 years.

A.287. I can remember what the cattle of Ireland were 40 years ago and I know them now, and I recognise that they have revolutionised the cattle there. But the Irish had a stock to draw upon which had been bred for 150 years?—Yes. They drew upon England. They had a pedigree to draw upon, but we have not got that.

A.288. I have been thinking of the improvement in Ireland and I have been asking myself how long it would take to have a similar change accomplished in India with no pedigree stock to draw upon?—I have never thought of the point. However long it is going to be, it has got to be done.

A.289. I think you will have to reckon in centuries and not in years?—I hope not.

A.290. You take rather a pessimistic view of private enterprise. You think it is hopeless to expect private enterprise to do anything?—So far it has been so in India.

A.291. Because it is unprofitable?—Yes, you see the rejection question is so difficult. Everybody I have talked to about it has asked me, "What are we going to do with the unfit?"

A.292. Was it hope of profit that encouraged private enterprise in England?—Yes.

A.293. How many landowners in England made profits out of cattle-breeding?—It was the tenant farmer who developed cattle-breeding in England.

A.294. He bought the cattle?—Yes.

A.295. But who bred them?—He bred them himself. Most of the great breeders that I have known were tenant farmers. There was Mr. William Duthie of Collynie. Where would you find a more public-spirited man, and look at the vast fortune he left as the result of this work.

A.296. But if you will look through the history of pedigree breeding in England and in Scotland I think you will find that landowners and private enterprise were at work for a very long time before the tenant farmer began to take up pedigree breeding?—The landowner was at work, but would you not admit it was a profitable thing for him? He was a public-spirited man no doubt, he wanted to make his tenants more successful; he felt that this was too big a job for them in the beginning and so he took it up; but in the end it was profitable for him. It was certainly profitable for his tenants, and that meant he would get his share in the end.

A.297. If you apply ordinary profit and loss methods to the account of landowners you would seldom show a profit on pedigree breeding?—I am not acquainted with that aspect of it.

A.298. It was private enterprise that made the stock of Great Britain?—But is not private enterprise in all countries actuated by a desire for profit?

A.299. *The Chairman:* Or public spirit?—The enterprises of most of the business men I have met aimed at making money in the end.

A.300. *Sir Thomas Middleton:* It was from that point of view, that I thought perhaps you were taking a narrow view of the possibilities of private enterprise among the landowners of India?—Probably I am not sufficiently acquainted with the subject, but that was my opinion. The men whom I have personally known, most of whom have been in Scotland, were tenant farmers who were interested in cattle-breeding and they made money on it.

A.301. Some of them do. I could mention some who do and some who do not?—I think I am correct. I think they did make a profit.

A.302. To go to the other end of the scale of breeders, I think you are a little too hard upon the *Rabari* of Gujarat. You put down the lack of improvement in Indian cattle mainly to the ignorance of the cattle-breeder and you mentioned in an answer in that connection that the *Rabari* was now a fodder thief. I find, however, that you have a good impression of their knowledge of stock. Do they not care for their stock?—They probably care for the stock, but they cannot get sufficient fodder.

A.303. Is that not an excuse for them becoming fodder thieves?—But it does not contribute to the improvement of the cattle.

A.304. It keeps the cattle alive?—It would be better if they were dead, if they cannot be properly fed.

A.305. That brings me to the next point, the question of fodder. I think on page 12 you sum up the position in a way with which I agree. You say this question will only be solved when it can be made profitable for the cultivator to rear cattle?—That is what we have got to aim at. We are trying to make it profitable.

A.306. What amount of produce would you require, in your opinion, to make the rearing of a cow profitable?—Two thousand five hundred pounds of milk a year per cow.

A.307. You will agree that the actual yield would vary very widely in different parts of India. 2,000 lbs. might be profitable in one part of India, while 3,000 lbs. would be required in another part?—The conditions would affect it of course.

A.308. What is the root condition?—The root condition is the quality of the animal, its capacity for producing milk. It is the degree of efficiency of the milk-producing machine, namely, the cow.

A.309. In connection with your point that the cultivator must go in for growing food, would the cost of production of his fodder be an important factor?—I have always contended that the shoe is rather on the other foot. He will not grow fodder, because the animal to which he has to feed it does not produce anything in return. That is what I have seen in this country at the shows where I have judged. You will always find in big areas like Central India, the bullocks that produce a return for their food are fat as butter, but the cows are not fit to be looked at. The cultivators say, "What does the cow give us in return?"

A.310. That is just the question I was going to ask you. Supposing a cultivator puts you that question in some particular tract, you would be able to say to him, "Well, a cow that yields you 2,000 lbs. brings you nothing, but a cow yielding 2,500 lbs. yields a profit"?—Yes, there would be something in that.

A.311. *Sir Ganga Ram:* What about the manure?—They say they keep them for manure.

A.312. There ought to be some credit given for the manure he gets?—You do not mean to say that the manure that the animal gives is sufficient return for his food?

A.313. No, but when you say that it gives no return you have to take that into consideration?—It is of value.

A.314. *Sir Thomas Middleton:* After that limit is reached, we will call it 2,500 lbs., the profit increases very rapidly?—The ratio goes up very rapidly.

A.315. Have you in any case issued information or bulletins showing how the rate of profit rises with the increase in the yield of milk?—I have not.

A.316. Has that been done in India to any extent?—I have not seen it.

A.317. The attention of the cultivator has not been drawn to what one may call the marginal limit in milk production and the rapid increase of profit after that margin has been passed?—I think not.

A.318. Now, we have been talking a great deal about the bull, but have said very little about the Indian cow so far, except to condemn her milk-yielding qualities. Is it not your experience that even among the Indian cows there is a very large individual variation?—Yes.

A.319. If you went into a district, such as any of those you have named, where there are good cattle, and were to select 100 cows, what percentage of those which you bought by inspection would you expect to turn out really profitable cows?—I have never bought any cows for these farms that were not profitable. All of them have been profitable.

A.320. That is pretty good testimony to the average quality?—Yes, but you could get very few, and in some districts you could not get any that were really worth buying from that point of view.

A.321. You mentioned in reply to Sir Henry Lawrence the Gir cattle. What sort of percentage would you expect with that breed?—You would probably get about 20 per cent of them pretty good, but there are a very small number of them left, and what is left are fairly good.

A.322. It happens that 20 per cent. is the percentage I got when I secured a herd of the Gir breed many years ago?—Yes, but you can hardly get them at all; it would take you three weeks to pick up a dozen.

A.323. If you were buying in Sind or in any other district where the cows are good, what sort of percentage would you expect to get?—I could pick up in Sind as many as I want, all good. I bought 3,680 for the Military dairies in Sind in 2½ years during the war and practically every one of them was good.

A.324. Can you give us some idea of the variation of yield?—2,500 lbs. to 5,000 lbs.

A.325. One would call a cow yielding 2,500 lbs. a good cow?—Yes, but Sind is an exception; you can still get plenty of good cows in Sind, but there is no other place that I know of in India where you can do that.

A.326. *Sir Henry Lawrence:* Any Karachi breeds?—Of the 3,680, there were about 250 of the Thar Parkar breed, and all the others were red Sindhi or Karachi breed.

A.327. *Sir Thomas Middleton:* In most districts in India, one could still find a small percentage; the quality remains in the individual cows in most districts; does it not?—No, not in many districts. In North Arcot I was judging at a show last year; there was not an animal in the show that we would have bought.

A.328. Not an animal giving more than 1,500 lbs.?—There was no animal giving 1,000 lbs.

A.329. On page 7 you set out the problems that you would like to take up?—Yes.

A.330. These are not arranged in any order of merit, are they?—Not particularly; I think myself that No. 1 is certainly the most important.

A.331. There is an enormous demand for *ghi* in the country?—Yes, and an extraordinary amount of adulteration takes place in connection with *ghi*.

A.332. The errors in the manufacture of *ghi* are mostly wilful. People know how to manufacture *ghi* very well, if they wish to?—Throughout the country they adopt one method; there is very little variation; my own opinion is that it is a very wasteful method.

A.333. *Dr. Hyder:* Have you ever seen Kashmere *ghi*?—I have seen it on the market.

A.334. Does it smell?—It smells high.

A.335. *Sir Thomas Middleton:* I understand that for sometime there was a large trade in casein in Gujarat?—There was.

A.336. What has become of that trade?—There is very little done now. It has such a bad name that the people in London will not buy it, or at least they do not look for it. It is too much adulterated, and it contains fat and rice meal very often, always butter fat; it is not properly washed out.

A.337. You mentioned that you have been consulted with reference to laws that were introduced in three Municipalities?—Yes, the three Municipalities wrote to us at one time or another.

A.338. What percentages of butter fat in milk are stipulated?—5 per cent for buffalo's milk I think, in all three cases, and 3·25 per cent for cow's milk as the standard minimum; 8½ per cent solids, not fat, in both cases.

A.339. You had a sufficient number of analyses at your disposal to enable you to fix these standards without much difficulty?—We had no difficulty at all; we had plenty of material; you see, they wanted a standard that would be within a safe limit.

A.340. *Professor Gangulee:* You test butter fat by the Babcock method?—By the Gerber method; it is the simpler method. The Babcock method is used in America, but it is the same principle.

A.341. *Sir Thomas Middleton:* I gather from your replies to other questions that the difficulty is not your lack of knowledge as to what the milk ought to contain nor is it due to the absence of legislation, but to the lack of enforcement of legislation?—That is so.

A.342. Do any prosecutions take place?—Yes, there are a few which take place in all places.

A.343. Are the fines negligible?—No; I do not know what they are now. They are not too low; they are fairly severe.

A.344. Is there imprisonment for repeated offences?—No; no imprisonment.

A.345. With reference to the incidence of rinderpest, can you say from your own knowledge whether rinderpest attacks the weakest cattle on the grazings, or whether it attacks indiscriminately the better kept and the poorer animals as well?—I think our experience of rinderpest on the Military dairy farms is that it attacks the poorest, and those that are in bad health are more likely to be attacked than the others.

A.346. You argue that there are far too many cattle in India, and therefore rinderpest may not always be an unmitigated evil?—Unfortunately, as the years go by, of course they gain a greater degree of immunity to rinderpest. Every generation is a little more resistant than the other.

A.347. *Professor Gangulee:* Your pure breeds are comparatively immune from rinderpest?—No; most of them are not immune, but we get some which have an immunity, which is evidently a Mendelian character.

A.348. *Dr. Hyder:* You say that your charge is the whole of India, including Burma. I want to know whether that is a small charge or a big charge?—It is a big one.

A.349. You think there is room for provincial institutes?—There certainly is.

A.350. Is yours a research institute, or what?—We have done practically no research so far. It is educational up to the present, and experimental to some degree.

A.351. It is only an educational institute, you say?—Yes.

A.352. You give a Diploma course?—Yes; we take also post-graduate students and short course students.

A.353. You admit there is room for many more such institutes in all the Provinces in India?—I think there is.

A.354. You have mentioned some of these problems which are awaiting investigation?—Yes.

A.355. Do you not think any one of these problems is enough to occupy the lifetime of one man?—It would certainly occupy a great deal of his time if he went to the end of it; there is no end of course in that sort of thing.

A.356. I suppose you would admit that behind these problems there are other problems connected with fodder and things of that sort?—Yes. You see, in regard to these problems it would not take a very long time to get sufficient information to be able to give the data to the country and indicate which is the best method of doing this or that, and which is the best method of avoiding loss in doing it. For instance, this throwing away of the by-products of *ghi* must mean an extraordinary loss to the country.

A.357. You refer to the butter-milk; do you not?—Yes.

A.358. Is not that drunk largely by the peasants?—In some parts it is; at certain times of the year when milk is scarce they drink it; at other times when milk is plentiful it is partly thrown away.

A.359. My experience of the Punjab is that in the winter season they make it into some sort of soup and they drink it in large quantities. Is that so?—Yes.

A.360. Are there other parts of the Empire in which such research people are investigating these problems?—No. There is no part of the Empire where they are investigating the problem of the treatment of the milk of the buffalo. It is the milk of the buffalo that we have to deal with now. *Ghi* is nearly always made from the milk of the buffalo.

A.361. I think your great problem is to evolve dual purpose breeds?—Yes; we must deal with the conditions as we have them.

A.362. Do you think you can get any assistance from such workers in other parts of the Empire?—No; we have to deal with these problems on our own; our conditions are different.

A.363. Can you get any help from Australia or Canada?—We get all the information they can give; but the particular question we have to tackle here is the question of buffalo milk. All the literature that we get from them refers to cows' milk.

A.364. Take the question of storage?—That is a tropical question. There is very little done under tropical dairying in any part of the world. Most of the great dairying countries that have gone ahead have been in more or less temperate climates.

A.365. *Sir Thomas Middleton:* With regard to dried milk, it is to be an investigation of the costs, I take it?—Costs and methods.

A.366. You would not use a drying roll?—It all depends. I should try the vacuum roll. I think we should get the best results here by spraying the milk into a hot chamber. There was a factory which worked on that system in Gujarat for a while, but it was allowed to fall to pieces after the war. They made a lot of it which sold very well in Europe.

A.367. The investigations are mainly of a commercial kind; you want to go into costs?—Costs and methods, and find out also what kind of stuff we can produce for the world's market. Our casein nobody will buy.

A.368. *Sir Ganga Ram:* Is there a milk factory in Mysore?—I understand Sir Alfred Chatterton is going to do something; but he has not done anything yet. There was one started in Gujerat. They put up a magnificent plant, but never made a tin of condensed milk.

A.369. *Professor Gangulee:* What are your views regarding the export of cattle?—I think myself we should encourage it for all we are worth. That is the one thing that will bring home to our people the value of pedigree. It will raise the value of cattle. A lot of Sindhi cattle are exported now; a small export trade takes place now.

A.370. You would not put a stop to it?—Certainly not.

A.371. You do not think that is a drain on the country?—No; not at all.

A.372. *Dr. Hyder:* Is this export trade in livestock or in meat?—In livestock.

A.373. You think it is a large volume?—No, it is a very small volume; it will be well to increase it.

A.374. *The Chairman:* Do you think the export of pedigree animals from Great Britain has been the chief cause of the improvement of the cattle in Great Britain?—I do, and in Holland.

A.375. *Professor Gangulee:* You said you would not have legislation with regard to the spread of cattle disease?—Not at present.

A.376. Have you any idea what effectual steps could be taken for the control of infectious disease?—The only effective step would be restriction on movement; but we cannot do that until you have an organisation fit to enforce it.

A.377. You must create an organisation?—Yes, you must have your organisation first, so that when you pass legislation it will not be a farce.

A.378. You suggest that you would like to have a number of dairy institutes all over the country?—I said there was room for them.

A.379. In the event of your having these dairy institutes all over the country, would you have them one in each Province, or would you divide the country according to the so-called dairy tracts?—As a matter of fact, the major Provinces, I think, would start one each; the smaller Provinces would probably utilise that belonging to their nearest major Province.

A.380. You would keep in view administrative units and not suitable dairy tracts?—I think myself that the whole country requires dairy produce, and it all requires cows. In the backward districts it is more important.

A.381. I was speaking of areas where the conditions might be favourable? —I do not think there is any part of India that could afford not to develop the dairy business, not only from the cattle point of view but from the point of view of the well-being of the people.

A.382. In England one should certainly have dairy institutes in Norfolk or Suffolk. But the National Institute of Dairying is located at Reading?—You are dealing with a very much more confined area there.

A.383. Gujarat, as you say, has very favourable conditions for dairying. Would you not like to have an institute there?—That is why I am so anxious to keep this factory there.

A.384. It would be desirable to have an institute in Bengal?—Yes.

A.385. If you had these dairy institutes, who would be the controlling agent? Would it be the Government?—If they were provincial, I take it, as things are now, they would be controlled by the Provincial Government.

A.386. If you establish a dairy institute on the basis I suggest you could get better advantages. Then it would not be in the jurisdiction of any particular Province?—It might not be; it might be run by the Central Government, and run with great advantage, I believe.

A.387. Then you would have, for example, a number of institutes just like this Institute of Dairying under the guidance and control of the Central Government?—It would be a good thing, I think.

A.388. *Mr. Calvert:* Do you think you could produce a dual purpose animal for the whole of India, or would you find difficulties invariably in the sub-montane and montane areas where you have these little terraced fields for which a very compact animal is required? Does that mean that you cannot get a dual purpose animal?—I see no reason why the dam of that bullock should not give a reasonable quantity of milk.

A.389. What about your rejection of the Dhunni breed?—I took an opportunity of studying that breed; I think we could introduce milk into it.

A.390. A dual purpose policy could not be extended throughout?—It could.

A.391. *Sir James MacKenna:* Have you attended the meetings of the Board of Agriculture?—Yes, since 1909.

A.392. What do you think about the scope and utility of that body? Can it be made more useful than at present?—I think it served a very useful purpose, a very great purpose indeed. I have enjoyed the meetings so much and obtained great assistance and benefit from them. I think it might be extended with benefit to the country very largely. It is the only point at which the members of the Indian Agricultural Service have an opportunity of meeting one another and of getting new ideas and of having their own ideas criticised. I say that the Board of Agriculture has done great work for agriculture in India, and I should be sorry indeed if it were dropped. I believe it could be extended and enlarged, to the benefit of the country.

A.393. Have you any suggestions to make in that respect?—I think myself that it could be enlarged as a general Board, that is, a Central Department, working through expert executive committees. That ought to make it less unwieldy, and probably take up a little less time.

A.394. *Sir Henry Lawrence:* You have mentioned one point on which you disagreed with the views and opinions expressed by Mr. Bruen. Are there any other points in Mr. Bruen's evidence which you think it necessary to explain or say something about?—There is one point. He stated that if the Military dairy farms had done at every farm what they have done at Ferozepore, and built up a pure Indian herd at each farm, as they have done at Ferozepore, the result would have been the same to them; meaning thereby, I take it, that we would have had their milk equally cheap and in addition have been able to contribute largely to the cattle-breeding policy of this country. I entirely disagree with that. To begin with, the Ferozepore herd was founded by taking the best cattle from all the herds in India, and that could only be done once. Secondly, Mr. Bruen quoted the fact that the average yield of the present herds at Ferozepore was practically as high as that of some of the cross-bred herds. That may be so, but it has taken 17 or 18 years to bring it to that point, and you had this equally high yield from the cross-breds in about 4 years, so that in the intervening period between the 4th and the 17th years the Military dairies would have lost a very large sum of money in the production of milk. That is a point on which I disagree with him.

A.395. Are there any other points of importance on which you disagree with Mr. Bruen?—I again entirely disagree with the statement made by Mr. Bruen that half-bred bulls sold or otherwise distributed by the Military Farms Department in India have injured the quality of Indian cattle and have introduced diseases amongst them. As a matter of fact practically no uncastrated cross-bred males were issued or sold by the Military Farms Department and very few cross-bred cattle of any kind were disposed of to the public by the Military Farms Department during the 15 years of my service with them, so much so that it is quite impossible that the few animals sold to the public could make any impression whatever on either the health or the quality of the cattle of India.

A.396. With regard to the milk-supply for cities, are you satisfied with the facilities which the railways give for the carriage of milk to cities?—My experience of the railways has been really very good. In War time, we sent enormous quantities of milk. We sent milk from Jubbulpore to Bombay and sold it there. I found the railways were very ready to meet us. They generally arranged a special rate, especially the Bombay, Baroda and Central India Railway.

A.397. Do you think they will meet the private producer in the same way?—I could not say. They put a special van on the Bombay, Baroda and Central India Railway to enable us to send milk to Bombay; we could only guarantee the traffic up to the end of the War.

A.398. Is it in existence now?—I do not know. We did not do it after the War.

A.399. *The Chairman:* You have mentioned the desire on the part of foreign countries to import into those countries the best native breeds. Have you looked round the tropical world to see whether you could find any animals which may improve the Indian breeds?—I have never had the opportunity of visiting the tropical world to see for myself. From all I can learn from correspondence, we have been carrying on correspondence for a great many years, they have nothing as good as we have.

A.400. How about Ceylon?—They use Sindhi cows very largely. There is a regular business there in Sindhi cows. I have myself bought some cows for the Government of Ceylon and shipped them. I had been to Ceylon last year, and I found they had very poor cattle.

A.401. Are you devoting any time to the improvement of the buffalo as a milk-yielding animal?—We have on our farm a small herd at Karnal, and we have a few here; but you can buy in the open market. If you go to the right place, you can buy good buffaloes to-day. That is not the present problem.

A.402. Is the practice of sending she-buffaloes in milk to, for instance, Bombay, milking them until they dry, and thereafter selling them, having a bad effect on the breeds?—It is done systematically and regularly. I do not think it has had a very serious effect on the breed.

A.403. Do you think it may have that effect in time?—I doubt it; it is hardly big enough to affect it.

A.404. Mr. Bruen told us that the difference in the melting point between the butter of the buffalo and that of the cow is a practical factor in its popularity?—Mr. Plymen, the Director of Agriculture in the Central Provinces, when he was Agricultural Chemist to that Government, made some very careful investigations into the subject, and he found that the melting point varied of course at different seasons of the year, from 7 to 9 degrees Fahrenheit. He published a pamphlet on the subject, which is available.

A.405. Which has the higher melting point, the butter of the buffalo or of the cow?—That of the buffalo is higher; it stands up much better to the heat.

A.406. Which is the better for cooking purposes?—That of the buffalo is better.

A.407. To revert to the question of draught animals, is hardness of the feet a very important quality of the draught animal?—It is an important quality.

A.408. Are you watching it here?—As a matter of fact, in our crossing experiments in the Military farms, we have not paid any attention to draught whatever. In the selection of cattle for dual purposes here, we have paid particular attention to the feet, but we have not had any trouble. The breeds that we have taken up have good hard feet.

A.409. Is it the case that in parts of the country which are hard and stony, they evolve an animal with very hard feet?—I think it would naturally be so. I have not found that the Sindhi, which has been bred in the northern part of India, has any better feet than the Hariana of the Punjab. They are both shod of course when they come to work.

A.410. At the very end of your memorandum you make a complaint against the Railway Companies, because they charge for the calves running with the dams at the same rate as they do for cows themselves?—They do so for passenger trains.

A.411. Have you ever made a complaint about it?—I took the matter up with the Government of India; Dr. Clouston took it up with the authorities; the correspondence lasted for a year and a half, but nothing came of it.

A.412. What did they say?—They said those were the rules, and they refused to give a refund. On a goods train, you may have your calves that are under 2½ feet high at the shoulder free, but by passenger train you have to pay the full charge for the calf. And according to their own rules not more than 8 can be put in a wagon, yet they put 16 in a wagon, including the calves.

A.413. Do you get an impression, from your long experience of India, that, taking one thing with another, the rural population is anxious for an improvement in the cattle-breeds?—I think they are, the better class of them. The poorer class breeder in the jungle tracts is really too ignorant; he is too much of a jungli to understand what it means, I think. But the breeder of the future must, I think, be the cultivator; he is certainly ready for the scheme, would welcome it, and would assist in bringing it about.

(The witness withdrew.)

APPENDIX I.

A.—Principal dual purpose breeds (types) of cattle (non-buffalo), in India.

Name of breed.	*Habitat.*
Sindhi	Western Sind.
Thar Parkar	South-eastern Sind.
Hariana or Hansi Hissar	South-eastern Punjab and parts of the United Provinces.
Ongole or Nellore	Guntur district of Madras.
Kankrej	Gujarat district of the Bombay Presidency.
Gir	Kathiawar and parts of Baroda State.
Krishna Valley	These are Nellore cattle bred in the Krishna Valley district in the Bombay Presidency.

B.—Principal single purpose breeds (types) of cattle (non-buffalo), in India.

Sahiwal (Montgomery)	Milk, Central Punjab.
Dhunni	Draught, Northern Punjab.
Bhagnari	Draught, Baluchistan and Northern Sind.
Kheri	Draught, Northern United Provinces.
Malvi	Draught, Central India.
Nimari	Draught, Central Provinces.
Khillari	Draught, Khandesh and North-eastern Bombay.
Dangi	Draught, Southern Maharatta country and hilly tracts of the Deccan.
Amrit Mahal	Draught, Mysore, South-eastern Bombay and parts of Madras.
Kangyam	Draught, Central Madras.
Burmese	Draught, Burma.

APPENDIX II.

Statement showing the Expenditure and Receipts of the three Farms at Bangalore, Wellington and Karnal and of the Office of Imperial Dairy Expert for the last three years.

—	1923-24. For 9 months only (July—March).			1924-25.			1925-26.		
	Total revenue expenditure.	Total receipts.	Capital expenditure.	Total revenue expenditure.	Total receipts.	Capital expenditure.	Total revenue expenditure.	Total receipts.	Capital expenditure.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial Institute of Animal Husbandry and Dairying, Bangalore.	1,09,840	1,17,599	58,093	1,55,294	1,76,001	34,740	1,41,380	1,51,391	32,460
Imperial Government Dairy Farm, Wellington.	58,714	70,312	15,975	79,109	86,408	8,918	87,785	83,913	18,195
Imperial Government Cattle-breeding Farm, Karnal.	27,014	75,211	77,947	68,079	71,918	44,371	86,017	78,351	28,407
TOTAL .	1,95,568	2,63,122	1,52,015	3,02,482	3,34,327	88,029	3,15,182	3,13,655	79,062
Office of Imperial Dairy Expert .	46,585	...	...	38,392	...	...	43,531	...	...

Mr. F. J. WARTH, Physiological Chemist, Bangalore.

Memorandum on the Animal Nutrition Section, Bangalore.

1. *History of the Animal Nutrition. Section.*—The New. Section dealing with Nutrition was started by me on October 24th, 1921, at Pusa. The initial work consisted in training a staff, testing methods of analysis, methods of sampling and the entire routine for digestion experiments. Trial stalls were set up and tested for their suitability in this country. After this preliminary work, land was procured and levelled, digestion stalls with the necessary adjuncts were constructed, and a series of digestion experiments was undertaken. A new form of nitrogen metabolism apparatus was devised by me at this time. The apparatus, which has been described in the *Agricultural Journal of India* (Volume XVIII, Part 3), was put into operation at Pusa and yielded some very interesting results. It was found, for instance, that the Bihar bullock maintained a nitrogen balance with a remarkably low proportion of protein in his ration. These and other results emphasised the need for studying the applicability of European standard rations to Indian cattle. The results of one year's work at Pusa were that preliminary tests had been completed, a temporary but efficient block of nutrition buildings had been set up, a satisfactory routine for digestion work had been established, and experiments were proceeding without a break. In addition to this the new nitrogen metabolism apparatus was in operation almost continuously. Some of the results obtained with rice straw in this early work were published in the *Agricultural Journal of India* (Volume XVIII, Part 5). Digestion experiments were also carried out with a number of concentrates from Government Military Dairies. I went on leave in April 1923 and Mr. A. V. Iyer, First Assistant to the Physiological Chemist, took over charge. The work proceeded smoothly until July 2nd when orders were received to transfer the Section to Bangalore. The transfer was effected efficiently and promptly by Mr. Iyer and on my return to duty in November 1923, I was posted direct to Bangalore. It became evident on my arrival that, if anything, the transfer had been too prompt. There was no laboratory and there were no stalls. The proposed laboratory was inadequate. Fresh plans were prepared and construction of the laboratory and stalls pressed forward. By great exertions and by working in half fitted rooms chemical analysis was commenced at Bangalore in July 1924. The transfer had, therefore, cost the Section exactly one year.

2. The following is the working accommodation provided at Bangalore for the Nutrition Section:—

(*a*) A chemical laboratory fitted up in a building which was originally a dairy store house. It includes a lecture room for the Dairy Diploma students, a store room and office rooms occupying 1,632·8 square feet. The laboratory rooms proper occupy 2,421 square feet.

(*b*) A new cattle shed occupying 1,200 square feet, specially constructed for nutrition experiments.

(*c*) Specially constructed store and preparation rooms occupying 900 square feet, for nutrition work, and adjoining the nutrition shed.

(*d*) A weighbridge brought from Pusa and housed in a specially constructed shed.

(*e*) A petrol gas plant in a small room specially built to accommodate it.

Last year a small extension was added to the laboratory and this year a barn and cattle shed have been sanctioned.

Mr. F. J. Warth.

3. *Staff.*—The Physiological Chemist's staff consists of:—

One Senior Assistant, Class II Service.

Three Junior Assistants.

One Fieldman.

One Clerk.

4. *The present system of recruiting staff on long-term agreements.*—I have been fortunate in my staff. Every man has worked loyally. Without devoted service it would not have been possible to carry out the immense amount of work which has been done in such a short time. In considering terms of recruitment it is my opinion that assured employment and definite prospects for good work will bring us more suitable men than we can hope to get in any other way. The primary selection must naturally be done carefully and the probationary period must be long enough to serve the intended purpose. Prospects of promotion on the one hand and the loss of increments on the other ought to be sufficient incentives generally to maintain efficiency in the service. There will be black sheep at times, but on the whole I would prefer to have a staff of permanent men interested in their vocation and their institution and assured of steady employment and advancement.

5. *The work of the Section at Bangalore.*—In commencing the study of Animal Nutrition in India the first question which had to be considered was what lines of work should be taken up. Some of the problems which have been met in other parts of the world are undoubtedly important in India. One of these, the mineral problem has been taken up without hesitation as certain to lead to useful results. There are also problems which are peculiar to the country and the climate. A few of these are obvious. There can be no doubt, for instance, that the coarse fodders require investigation. But we have no assurance that the obvious problems include the most vital. Hence the second question arises. How are the real needs of the country to be tracked down systematically? This can only be done by carrying out numerous feeding tests and procuring first-hand knowledge of the nutritive effect of all kinds of Indian foodstuffs. Experience with a wide range of materials and data for comparative purposes will reveal the requirements. The guiding principle at Bangalore is, therefore, the collection of wide experience. The Section has carried out as many feeding tests as possible wherever and whenever an opportunity offered. The tests have been done invariably with a definite limited object in view and corresponding definite information has been gained; but there has been always behind these tests the general idea of a search for more fundamental problems. It will be seen, in what follows, that the procedure has been completely justified. Already at this early stage of the work matters of wide significance are emerging from these initial experiments. The Section made a start at Bangalore in July 1924, when the laboratory was able to commence analyses. The lines of work which have been developed since that date are described under the following heads.

(a) *The testing of feeding standards.*—As nothing whatever was known about our foodstuffs the first experiments undertaken at Bangalore were tests to determine the applicability of European and American standard rations to this country. Tests dealing with milk production and the growth of heifers have been carried to a conclusion. The results have been prepared for publication and will be issued shortly as Memoirs of the Department of Agriculture. The main facts elucidated so far may be condensed into a few words. It was found that the American digestion data could not be applied without modification to our rations. The experiment with our cross-bred cows showed that they were slightly more efficient in the utilisation of food than pure-bred American cows. The higher efficiency is accounted for by a better digestion of fibre.

Eckles in America has shown that the energy value of the milk produced by a cow is greater than the net energy of the food available for milk production, *i.e.*, food is more economically used for milk production than for maintenance or growth. The Bangalore tests confirm and amplify this conclusion. The figures of Eckles in America and the Bangalore results are shown together in the accompanying chart [Appendix III (*a*)]. The work on milk production necessitated a large number of milk analyses. The accompanying graph [Appendix III (*b*)] shows how closely the Bangalore Dairy milk corresponds to average figures from America. Experiments on growing heifers showed that our cross-bred animals required somewhat more net energy for growth than is allowed by Armsby's standard. Compared with the Wolf Lehmann standard they utilised the standard amount of crude protein and somewhat less than the standard amount of total nutrients. The long series of valuable digestion data obtained in the course of these experiments cannot be quoted here. More work on Sindhi cattle remains to be done.

(*b*) *The rationing of young stock.*—The work with young stock is important for a number of reasons. Considering first the animals themselves—they have not developed their digestive systems and require special food on this account. Then the food should be of such a nature that it will act favourably upon the development of a good digestive system. Finally the young growing animal requires relatively speaking an enormous amount of nutrient to support the demands for growth. This must be provided by the food in suitable form and proportions. Economically the feeding of unsuitable or insufficient food results in very serious loss. It involves a great waste of foodstuffs on unproductive maintenance, a waste of the animal's capacity to utilise food productively and a waste of health or ability to resist disease. In studying foodstuffs the young animal is especially useful. The demands for growth being more rigorous than the demands for maintenance, the shortcomings of a foodstuff tell more quickly and more decisively with young stock. For these reasons the Nutrition Section is constantly increasing its work on young stock.

An interesting and useful experiment with calves was concluded four months ago at Bangalore. The animals were divided into three groups receiving different types of concentrates which contained, respectively, A13·9 per cent, B26·9 per cent, C30·3 per cent, protein. The quantities fed were so selected that the net energy provided by the concentrates A and B were equal whilst the protein content of B was much higher. Ration C provided more protein but less net energy than rations A. Roughage was given *ad lib.* The amounts of concentrates fed and the growth obtained are shown in the following table.

TABLE 1.—*Showing amounts of concentrate given and live weight increases obtained.*

——	Ration A.	Ration B.	Ration C.
Total concentrate fed per 1000 lbs. live weight.	21·3 lbs.	16·0 lbs.	10·7 lbs.
Protein supplied in concentrate per 1000 lbs. live weight	2·97 „	4·31 „	3·25 „
Net Energy supplied in concentrate per 1000 lbs. live weight	11·49 „	11·49 „	10·70 „
	Therms.	Therms.	Therms.
Average daily increase per 1000 lbs. live weight	5·72 lbs.	5·43 lbs.	4·39 lbs.

The figures show that with these rations growth is not proportionate to the protein but runs more nearly parallel to the net energy of the concentrate. The fate of the food-protein is shown in the following data obtained from a nitrogen balance experiment with six of the calves.

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Table 2.—*Nitrogen balance experiment with six calves.*

Grams per day.	Ration A.		Ration B.		Ration C.	
	Calf 1.	Calf 2.	Calf 3.	Calf 4.	Calf 5.	Calf 6
Total Protein Nitrogen in ration	53·42	56·50	95·05	68·60	78·14	55·77
Nitrogen digested . . .	32·88	34·22	67·33	49·36	51·84	36·01
Nitrogen excreted in urine .	14·23	13·36	48·66	30·31	35·90	24·02
Nitrogen retained for flesh formation	18·65	20·86	18·67	19·05	15·94	11·99

In ration A the amount of nitrogen digested is low but excretory losses are also very low and hence the balance retained is satisfactory. In ration C the amount of nitrogen digested per 1000 lbs. live weight is much higher but the retention is less perfect. In these experiments, as already stated, roughage was provided *ad lib*, but the actual amount consumed daily by each animal was accurately determined. The roughage consumption together with other significant figures is given in the following table:—

Table 3.—*Average daily consumption of dry matter in lbs. per 1000 lbs live weight.*

—	Average Live weight lbs.	Daily increase per 1000 lbs. Live weight. lbs.	Food consumed per 1000 lbs. live weight.			Amount of roughage to 1 of concentrate.	Per cent. digestion of ration.
			Roughage.	Concentrate.	Total.		
A Ration .	218	5·72	10·83	16·25	27·08	·781	59·8
B Ration .	217	5·43	13·02	13·06	26·08	1·130	60·6
C Ration .	207	4·39	14·84	8·68	23·52	1·899	60·0

This table contains important information. The figures show in the first place, as was to be expected, that high allowance of concentrate is accompanied by low consumption of roughage and *vice versa*, that the highest total consumption occurs when concentrate is high and that the live weight increases run parallel with the total consumption. The last fact is especially significant. It appears that the total amount of organic matter digested and the percentage digestion are very important measures of the actual value of a ration, and that the proportion of protein may vary within wide limits without influencing the rate of growth. The actual quantities of food consumed and growth obtained in this experiment are expected to be valuable guides to the practical dairy cattle feeder in this country. The results in such feeding tests however depend very much upon the nature of the roughages employed. More experiments on these and similar lines are required to determine suitable concentrate allowances for the various roughages. It is proposed to deal with this subject more systematically when the entire Bangalore Dairy herd can be exploited for experimental purposes. That the roughage (sorghum silage) used in the above experiment was of high quality is shown by the figures in the two last columns. The digestion attained remained at the same level when the proportion of roughage was more than doubled. The experiment is finally of interest in showing what can be accomplished with ordinary Indian foodstuffs. A consumption of 27 lbs. of dry matter per 1,000 lbs. live weight by Indian stock weighing 200 lbs. is good, and the growth obtained, over a pound a day per head for a period of 100 days, is encouraging. It should be mentioned, however, that all the animals referred to in this experiment received a mineral supplement to their ration. This point will be dealt with later.

(*c*) *Indian coarse fodders.*—Under this head it is intended to carry out a systematic study of the chief Indian roughages. We possess a certain amount of information concerning our concentrates. We can assign fairly definite food values to very many of them. With the Indian roughages the situation is altogether different. We do not know the elementary facts regarding their digestibility, energy value or other characteristics. Further, as the roughage forms the bulk of the ration, malnutrition and nutritional diseases almost invariably arise from deficiencies in the roughage. The enquiry on coarse fodders is, therefore, an urgent matter. The tests which have been adopted for this work at Bangalore are rigorous and searching. The experimental animals are kept on the ration for a long period and at different stages of the feeding tests digestion experiments and nitrogen metabolism experiments are carried out.

The first series of tests were made with rice straw and Indian baled hay. The experiment came to an end recently and has yielded most interesting information. Accurate digestion data have been procured and the net energy values of the two roughages have been determined indirectly. It was found that our rice straw has a decidedly higher net energy value than that assigned to the American product. The hay was inferior to average American hay.

These figures will be of the greatest use for rationing purposes, and, in fact, the Military Dairy Farms department has specifically asked the Nutrition Section for information which these figures provide. At the last Board of Agriculture meeting at Pusa an informal meeting between the officers of the Military Dairy Farms and the Physiological Chemist took place. The latter asked what information the Military Dairy Farms needed most of all and was told that information on maintenance rations was urgently required. Recently, also, in a private communication, Lieutenant-Colonel Matson, Assistant Controller of Military Dairy Farms, said that above everything they wished to know the effective values of rice straw, hay, wheat straw and *juar*. As the maintenance ration is calculated directly from the net energy value of a foodstuff and the effective value is the net energy value, the Nutrition Section has been able to supply the desired information promptly. The fact is the experiments which provided the information were commenced ten months before the query came, which shows that the Section had selected appropriate work.

The information gleaned from this experiment does not end here. In the course of the work a remarkable physiological effect due to rice straw was discovered. It was found that rice straw produces persistent diuresis, and the cause of this diuresis was traced to the high potash content of the straw. The animal is obliged to get rid of the excessive intake of this base. The figures in the following table taken from a paper recently submitted for publication by the Nutrition Section bring out these facts clearly.

TABLE 4.—*Average excretion of urine and potash by animals fed on rice straw and hay respectively.*

	1000 lbs. animals		750 lbs. animals.		500 lbs. animals	
—	No. 1 Straw.	No. 2 Hay.	No. 1 Straw.	No 2 Hay.	No. 1 Straw.	No. 2 Hay.
Average daily urine excretion in kilos—						
1st test. Apl. 1925	7·871	3·947	7·797	3·665	6·299	3·219
2nd test Sep. 1925	6·830	2·842	5·877	3·021	4·968	3·141
3rd test. Nov. 1925	7·572	3·329	7·223	3·338	5·745	2·563
Average	7·424	3·373	6·966	3·341	5·671	2·974
Average daily potash excretion in urine in gms.—						
1st test. Apl. 1925	92·50	33·14	83·77	27·11	61·43	20·14
2nd test. Sep. 1925	100·30	31·50	92·20	26·30	67·13	21·52
3rd test. Nov. 1925	130·58	33·50	119·53	31·27	90·07	22·21
Average	107·79	32·71	98·50	28·23	72·88	21·29

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It is impossible to say, at present, what the effect of this diuresis will be. Up to a point the elimination of urine is a healthy symptom. It may be expected to clear the system. On the other hand, the excretion of very large amounts of urine, or of urine of abnormal reaction, is a strain on the kidneys and must inevitably lead to serious results.

That the urinary excretion may be profoundly affected by the nature of the roughage consumed, is, therefore, a discovery of great significance. It is possible that a subject of fundamental importance to animal nutrition in India has been met with here. The question is being followed up tentatively at present. In the first place a circular letter has been sent to the Provinces asking for samples of typical rice straw from all parts of India and Burma. Secondly, pending the arrival and arrangement of this material, the diuretic effect of other roughages has been studied. Ranges of variations in urinary excretion have been observed which exceed the above-noted difference between rice straw and hay. For example, the figures for the average daily excretion produced by two roughages recently examined were found to be 2·50 and 15·55 kilos, respectively.

The systematic examination of Indian roughages is proceeding. A second series of tests, on a somewhat larger scale, with more bullocks and intended to deal with four new roughages has been commenced. The intention in this work is to add steadily to its utility and scientific significance by increasing the number and nature of the observations made during the long period of feeding. Some clinical tests will be introduced this year and eventually it is intended to do respiration experiments with these animals.

(d) *Mineral requirements.*—Recent work in Europe has shown that the productive capacity of an otherwise sufficient ration may be completely lost through inadequacy of the mineral supply, and conversely it has been found that the addition of appropriate minerals in such cases greatly enhances the productive capacity of the food. It is impossible to lay too much stress on this question in India. Mineral shortage is common and it must lead to a waste of the potential nutritive power of the organic matter produced by plant growth. Experiments on mineral supplements required for growing stock have been commenced at Bangalore. The test with calves, mentioned above, was used mainly to decide on suitable rations for this purpose. A comparative test was, however, carried out concurrently, a check lot being fed on the same rations, but without a mineral supplement. There was a marked and consistent difference between the controls and the lime-fed lot in favour of lime feeding but stress is not laid on this preliminary result at present. Appropriate rations having been fixed, a more extensive experiment focussed solely on the mineral question has been started. The subject of mineral supplements was, however, deemed of such importance that efforts were made to amplify the work at Bangalore by using outside resources. For this purpose preliminary experiments have been carried through at Hosur (the Central Cattle Breeding Station of the Madras Department of Agriculture) and plans are ready for a trial there during the coming season. A somewhat different experiment relating to the same subject has been proposed to the Military Dairy Farms. The proposal has been accepted and the work will commence as soon as this Section can spare the necessary staff. In the preliminary experiment at Hosur mineral tests were not attempted. A simple feeding experiment to compare hay and grass silage was carried out in order to study the conditions of work there. Thanks to the facilities given to this Section by my friend Mr. R. W. Littlewood, Deputy Director of Agriculture, Livestock, Madras, the effort has been an unqualified success. The results obtained in the first Hosur experiment, though they do not deal directly with the mineral question, deserve notice. Sixteen animals were selected for the experiment. They were carefully paired and divided into two groups. The one group was given hay, the other silage. A weighed excess of roughage was fed to each animal and the residue left by each was weighed daily. Both groups received the same amount of concentrate, namely, one pound cake and 2 lbs. rice bran per head. The animals themselves were weighed daily during the entire experimental period which lasted 13 weeks. The main results obtained can be shown in a condensed form. The following figures give the changes in live weight which took place during the feeding period.

	Silage group.	Hay group.
Final average live weight per head lbs. .	514	471
Initial average live weight per head lbs. .	485	474
Average increase per head lbs. .	+29	−3

There can be no doubt that the silage was more effective than the hay. To give force to these figures it should be observed that the average live weight per head is taken from the weekly average live weights of 8 animals. Each figure in the table is, therefore, derived from 56 live weight determinations. The first impression from these figures is that silage is far more nutritious than hay. This is not the case. They are probably about equally nutritious. The difference in effect is entirely accounted for by the quantities consumed. The average consumption of dry matter from roughage per head per day was found to be:

for the Silage group	8·363 lbs.
for the Hay group	5·860 lbs.

These are striking and important figures. This experiment has yielded much valuable information. It has shown in the first place that a productive ration cannot be obtained from spear grass hay. The animals consume just enough to maintain themselves. In the second place, it has shown the advantage of converting spear grass into silage. The silage is probably not more nutritious but it is consumed more readily and in amounts above the maintenance requirement. Hence it becomes a productive ration. The hay fed for 13 weeks—together with concentrate be it noted—gave no return whatever. The economics of cattle-rearing are beautifully illustrated by these figures. The experiment has also yielded material from which the nutritive values of the roughages can be determined. The necessary analyses for this purpose however have not been completed yet.

Finally it has to be noted that the rate of live weight increase even with the silage is far from satisfactory. Further experiments are being arranged to investigate this point.

To be fair to the work of this Section the figures for average dry matter consumption per head given above must be referred to once more. They are the figures that have elucidated the real meaning of silage efficiency. These two figures for dry matter consumption are the result of an enormous amount of work. Not only was the ration and residue of each animal determined daily for a period of 13 weeks, but the daily variations in moisture content of the hay and silage had to be allowed for, and in addition to this the partial drying up of the silage while it lay in the trough had to be taken into account daily. To carry out a test of this kind entails labour and demands a great deal of organisation. It is work which can only be done by trained men and a trained staff. In this case, too, it was done at an outstation and not at headquarters. The Section should have more men for dealing with work of this kind.

(e) *Indian pasture grasses.*—This work follows along the lines of the most recent observations upon pasture land which have been made in England. Here again the Section has been fortunate in finding outside support. A large amount of work including analyses, digestion experiments and long period feeding tests is in progress at Bangalore on material supplied by the Military Grass Farms. The Bombay Department of Agriculture has taken a

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great deal of interest in its pasture problem for many years past. The Nutrition Section, having approached the Bombay Department, is to be provided very shortly with most valuable material from this part of the country. Finally on the strength of the Hosur feeding experiments, already referred to, the Director of Agriculture, Madras, has agreed to the necessity for laying down new grass at Hosur. This is a most important experiment which will eventually provide further material for crucial tests by the Nutrition Section. The work on pasture grasses is particularly important because recent work in England has shown that there is a real prospect of increasing productivity in this direction in India. The work outlined above aims mainly at a determination of the variations in quality which are to be expected. The next step must be an attempt to obtain higher productivity from definite areas which the present experiments are expected to locate for us. This work will involve careful feeding experiments carried out on the spot. The Nutrition Section must have the staff and organisation ready for this approaching task.

(f) Work in the Provinces.—Work in the Provinces is undertaken for the following reasons:—

1. To get in touch with local nutrition problems and conditions.
2. To amplify the work at Bangalore.
3. To test foodstuffs which cannot be conveniently tested here.

Most of the work under this head has been referred to already in connection with the special subjects. An experiment carried out at the Imperial Cattle Breeding Farm, Karnal, which has not been mentioned so far, deserves to be noticed here. The experiment was designed to test the value of different local coarse fodders for winter rationing of calves. The calves were divided into 4 lots receiving, respectively, *dhub* hay, rice straw, sorghum straw and wheat straw, *ad lib*. Concentrate was given in equal amounts to all the animals. Live weights were determined daily and the quantity of roughage consumed by each calf was also determined every day. The results obtained in this long period test covering 120 days are given in a highly condensed form in the following table:—

Ration.	Average live weight per head.	Average weight increase per head.	Average daily roughage consumed.
	Lbs.	Lbs.	Lbs.
Hay	301	·31	5·58
Rice straw	297	·61	6·96
Sorghum straw	300	·57	6·74
Wheat straw	297	·41	5·44

It should be observed that each live weight figure is the average of 42 weighings of 5 animals. Each figure for live weight increase is the average difference between two sets of 21st weighings of 5 animals. The roughage consumption was determined for each animal for 120 days. The figures show that rice straw was most greedily consumed and gave the highest live weight increase. This result is contrary to local opinion which holds that wheat straw is preferable, and the preference is so strong that the local price of wheat straw is four times that of rice straw. A fact of considerable economic significance has been arrived at here. The sorghum may have been somewhat too tough for such young animals and might conceivably show much better results with older stock. The hay result is certainly remarkable. That rice straw should give better results than *dhub* hay, which is believed to be one of the most nutritious grasses in India, is a matter deserving attention. It is noteworthy that these experiments were carried out during the three

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coldest months of the year. There is a possibility, therefore, that we have found a fodder which is particularly suitable for the cold season. The point has cropped up by chance, but there is no doubt that if we can recommend special rationing to help the animals through the months of intense cold a very important result will have been achieved. Experiments to test the possibilities in this direction are being prepared. To sum up the results of the first series of tests at Karnal, they have yielded firstly information of economic value which the active Superintendent of that Farm is already making use of; secondly, they have indicated lines for further enquiry one of which has been discussed above.

With regard to all the work in the Provinces one point requires to be noticed. The Section has so organized the plan of procedure to be employed that we are ready to carry out feeding tests in any part of the country. Some time ago the Section carried out a digestion experiment with perfect success at Karnal in the Punjab. More recently a very elaborate feeding test, with 16 calves, a digestion experiment with 8 animals and a nitrogen metabolism experiment with the same 8 animals was carried out without a single hitch by the Section at Hosur in the Madras Presidency.

(g) *Training of Post-Graduate students in Animal Nutrition.*—This work was taken up by the Section voluntarily. It is a valuable means for disseminating a knowledge of, and an interest in, animal nutrition throughout the Provinces. The course of training which covers one year includes:—

1. An advanced lecture course on animal nutrition.
2. The planning and carrying out a nutrition experiment under the direction of the Physiological Chemist.
3. The study of all nutrition experiments in progress here.

The work is thoroughly practical. The students have to handle and care for the animals in their charge and have to study their feeding capacity and rationing. Seven students have completed the course up to date.

(h) ***Assistance given by the Nutrition Section to the Section of the Imperial Dairy Expert.***—1. Courses of lectures on Chemistry (by an Assistant in the Nutrition Section) and on animal nutrition (by the Physiological Chemist personally) were provided for the Dairy Diploma students.

2. The Imperial Dairy Expert asked for a practical procedure for accurate cream neutralisation in connection with pasteurisation. The Nutrition Section carried out an investigation of the question. A practical process was evolved and handed over to the dairy in a workable form.

3. A question relating to cheese-making has recently been submitted to this Section. At present preliminary enquiries are being made.

I would like to record here my deep appreciation of the wholehearted support which my friend Mr. William Smith, Imperial Dairy Expert, has invariably given to this Section, and often it has been given at considerable inconvenience to himself.

6. *Advisory work for Provincial Departments.*—Applications for advice have been received from the Director of Agriculture, Bihar and Orissa, and from the Military Dairy Farms regarding mineral supplements. The required information was supplied. Detailed plans for feeding experiments have been prepared for the Madras and Mysore Departments of Agriculture. The Military Dairy Farms specially asked for information on maintenance rations. One set of results obtained at Bangalore has been provided. Further figures will become available from work which is proceeding now. Questions from the United Provinces relating to the digestibility of certain foodstuffs were replied to. Assistance given to the Imperial Dairy Expert has been mentioned in another place.

7. *Publication.*—The work of publication has just commenced. The results of the first year's experiments (1924) have been embodied in two

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Memoirs which are in the press. The completed experiments of 1925-26 will form four Memoirs, but the writing up of this work is only half done. The subjects dealt with are:—

1. Nutrients required for milk production with Indian foodstuffs.
2. Nutrients required for growth production with Indian foodstuffs.
3. Bangalore maintenance experiments, 1st series.
4. Calf feeding experiments at Bangalore in 1925.
5. The relative feeding values of hay and grass silage, Hosur experiments, 1925-26.
6. Roughages for winter feeding of young stock in the Punjab, Karnal experiments, 1925-26.

The following articles have been submitted for publication in the *Agricultural Journal*:—

1. The application of feeding standards to dairy cattle in India.
2. Factors influencing the cost of food for milk production.
3. The relationship between digestibility and net energy values.

8. *Provision for training men for the highest post in the department.*—This Section provides such a training in the Post-Graduate course already referred to, but so far no students have come who could be trained to this extent. Some of the students were altogether unsuitable, owing to inadequate previous education. I will consider only the case of the best men we have had. They were a fine type. They had character and personality, they were gentlemen and my relations with them have been intimate and cordial. It has been a real pleasure to me to have had them here. With regard to their work I can say that they applied themselves to it with zeal and enthusiasm and some of them devoted themselves to it. I must also add that I consider almost all of them fully appreciated and grasped the significance of the work and the possibilities it opened out. They left Bangalore with a sound knowledge of the principles of animal nutrition. But when I am asked whether the men were fit for the highest posts in this subject in the department I have to say definitely—No. Men taking a Post-Graduate course in animal nutrition might be expected to fill a post of:—

1. Animal Nutrition Expert.
2. Cattle Expert or Dairy Expert.
3. Deputy Director of Agriculture.

To become a Nutrition Expert it is essential to have specialised in Chemistry at least. The man who takes up this work must be able to guide the ordinary laboratory processes and deal with the chemical problems which arise. Not one of the men who came here had received the necessary education in Chemistry, not one of them was in a position to discuss procedures with an apprentice in the laboratory. They had received a good general scientific education up to the Intermediate standard, but the final 18 months of study devoted to one or two major subjects had been entirely omitted. My contention is that no amount of post-graduate technical training can make up for this want of scientific training. The point is well illustrated by the case of the man who has not had a chemical training. He may do post-graduate work on animal nutrition for years and yet he will not be qualified to undertake the duties of a Nutrition Specialist. It should be emphasised that the Nutrition Section cannot undertake the additional task of teaching chemistry—for which purpose the Universities exist. It is not for me to say what special qualifications a man should possess to become a Cattle Expert, a Dairy Expert or a Deputy Director of Agriculture, but the modified animal nutrition course which my post-graduate students went through would be of the greatest help to them in any one of these posts. The Nutrition Section feels that this thoroughly practical course should be recommended and should be taken advantage of because there is a real need to disseminate interest in animal nutrition throughout the country.

9. *Short courses of lectures on special subjects.*—The Section provides a course of lectures on special subjects for the Dairy Diploma students. These lectures, however, constitute a systematic course and not what is usually understood by the term short course. This course of lectures is mentioned elsewhere.

The Physiological Chemist has also given a course of popular lectures on animal nutrition to officers of the Co-operative Departments. The lectures were combined with demonstrations and dealt mainly with the nutrition problems which are being investigated here. The officers who attended these lectures showed great interest in the work and asked many questions.

10. *Co-operation with other departments.*—During the first year of work at Bangalore (1924) the Section was fully engaged in getting its own experiments started. Tentative efforts were, however, initiated for co-operative experiments. Proposals were made to the Madras and Mysore Departments of Agriculture for feeding tests to be carried out at Coimbatore and Rayankere, respectively. Detailed instructions were given. For the former scheme the Nutrition Section merely advocated a trial and gave advice. In the latter scheme the Nutrition Section took a more active part, undertaking all the analyses and the supervision of a digestion experiment. These preliminary efforts were not successful. In one case, feeding instructions were not properly observed, in the other case, the food-supply ran out because the department in question preferred to test a roughage of which the supply was limited rather than the one recommended by the Nutrition Section. The experiments nevertheless served a purpose in showing these departments that such work was likely to be useful. The departments named are contemplating further tests at these stations. During the second year (1925) the Section was in a better position to co-operate with other departments. The initiative in all the co-operative schemes which have been inaugurated during the past year has invariably been taken by the Nutrition Section. The co-operative experiments, which constitute a large fraction of the activities of the Section, have been described already under various heads. It will suffice here to give a list of them.

List of co-operative experiments initiated by the Nutrition Section during 1925-26.

(1) *Madras Department of Agriculture.*—(*a*) Feeding experiments at Hosur. The cattle, the foods and the accommodation are provided by the Madras Department. The work, including a long period quantitative feeding test, a digestion experiment and analysis, are done by the Nutrition Section.

(*b*) Grass experiments at Hosur. The necessity for this work was urged by the Nutrition Section. The first part will be carried out by the Madras Department. The Nutrition Section will institute tests at a later stage.

(2) *Bombay Department of Agriculture.*—(*a*) The Nutrition Section proposed an examination of grazing area herbage. The Bombay Department Committee on pasture problems readily agreed to co-operate in this work.

(*b*) Requests have been made by the Joint Director, Bombay, to the Nutrition Section to carry out certain feeding tests. The Section unfortunately could not undertake the tests this year owing to shortage of staff and very great pressure of other work. It is hoped to meet the wishes of the Bombay Department next year in this matter.

(3) *Military Grass Farms and Military Dairy Farms.*—(*a*) Examination of Indian hay. The work includes analyses of types, digestion trials with types and long period feeding tests with types. The Nutrition Section

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carries out all the work at Bangalore. The material is supplied free of charge by the Military Grass Farms. I must acknowledge the zeal with which the Military Grass Farms have taken up the enquiry. Every question is promptly and fully considered; every request is immediately met.

(*b*) Feeding experiment at Jubbulpore. This work has not been commenced owing to shortage of staff.

(4) *Imperial Cattle-breeding Farm, Karnal.*—The experiments designed by the Nutrition Section for Karnal were ably carried out by the Superintendent of the Farm. The digestion experiments and the analytical work were done by the Nutrition Section. The Nutrition Section is very greatly indebted to the Agricultural Adviser, Dr. Clouston, for the financial assistance which he gave for this work.

11. *Obstacles.*—(*a*) The distance of the dairy from residential areas is a very serious drawback to the work. The average distance covered by every man working in the Nutrition Section from the Physiological Chemist down to the humblest menial is 7 miles a day. My men have worked splendidly in spite of this great disadvantage, but the strain is telling on them; there is constant illness and work is falling off. Quarters are required on the spot to remedy the state of affairs.

(*b*) The cross-breeding principles on which milk production at Bangalore is based are an endless trouble to the Nutrition Section. The Dairy only wants half-bred cows. No other stock is of any use. The procedure is that a number of country cows are brought with calf at heel. The cows have been spoilt before they arrive. They will not drop their milk without being suckled. Consequently neither the calf nor its dam is available for experiment. The next lot of calves are half-bred, but the trouble with the mothers persists and the situation remains unchanged. The half-bred cows are excellent in every way. They can be milked without trouble and are available for experimental purposes, but their offspring are useless mongrels which the Dairy sells as soon as possible. Recently I wanted 32 calves for an experiment. Only 8 could be provided out of the large herd. Both Karnal and Hosur have been able to provide as much stock as the Nutrition Section could use. It ought to be made quite clear that there has been no lack of good will on the part of the Dairy, and indeed only good will is to be expected seeing that the Nutrition Section saves the Dairy a certain amount of trouble and expense and generally hands back greatly improved stock. There is no lack of good will but there is a serious lack of material. The remedy is to put the Dairy on an experimental basis, which would enable it to breed and select country stock. To take up this work, I consider, a man with special qualifications would have to be put in charge of the herd.

(*c*) The Nutrition Section should have a few acres of land for growing crops. The need for this has not been absolutely essential up to the present, but it is likely to become more urgent as to the work progresses.

(*d*) Reference has only been made to such obstacles as are interfering with work actually in hand. For further development other obstacles would have to be dealt with.

APPENDIX I.

Statement showing sanctioned staff of the Physiological Chemist, the Imperial Institute of Animal Husbandry and Dairying, Bangalore.

Staff.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.
1. *Superior staff*—					
Physiological Chemist .	1	1	1	1	1
2. *Subordinate and Gazetted Provincial Officers*—					
First Assistant to the Physiological Chemist.	1	1	1	1	1
Laboratory Assistants .	2	2	3	3	3
Fieldman . . .	1	1	1	1	1
Clerk	...	1	1	1	1
3. *Inferior staff*—					
Laboratory servant. .	1	1	1	1	1
Peons	3	3	3	3	3

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APPENDIX II.

Statement showing the Expenditure and Receipts of the Physiological Chemist, the Imperial Institute of Animal Husbandry and Dairying, Bangalore.

	Rs.	A.	P.
Expenditure—			
1921-22	21,114	0	0
1922-23	38,479	0	0
1923-24	52,499	3	6
1924-25	51,838	4	11
1925-26	46,069	13	7
Receipts	*Nil.*		

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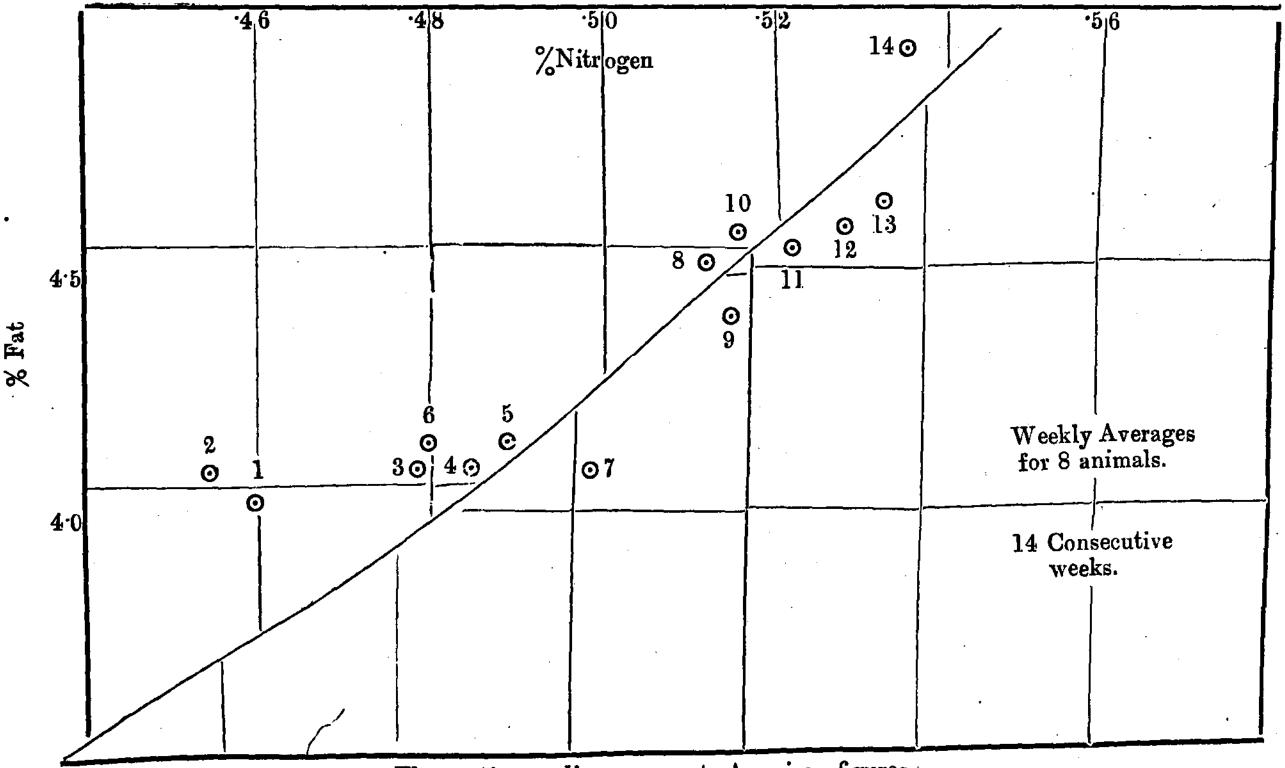
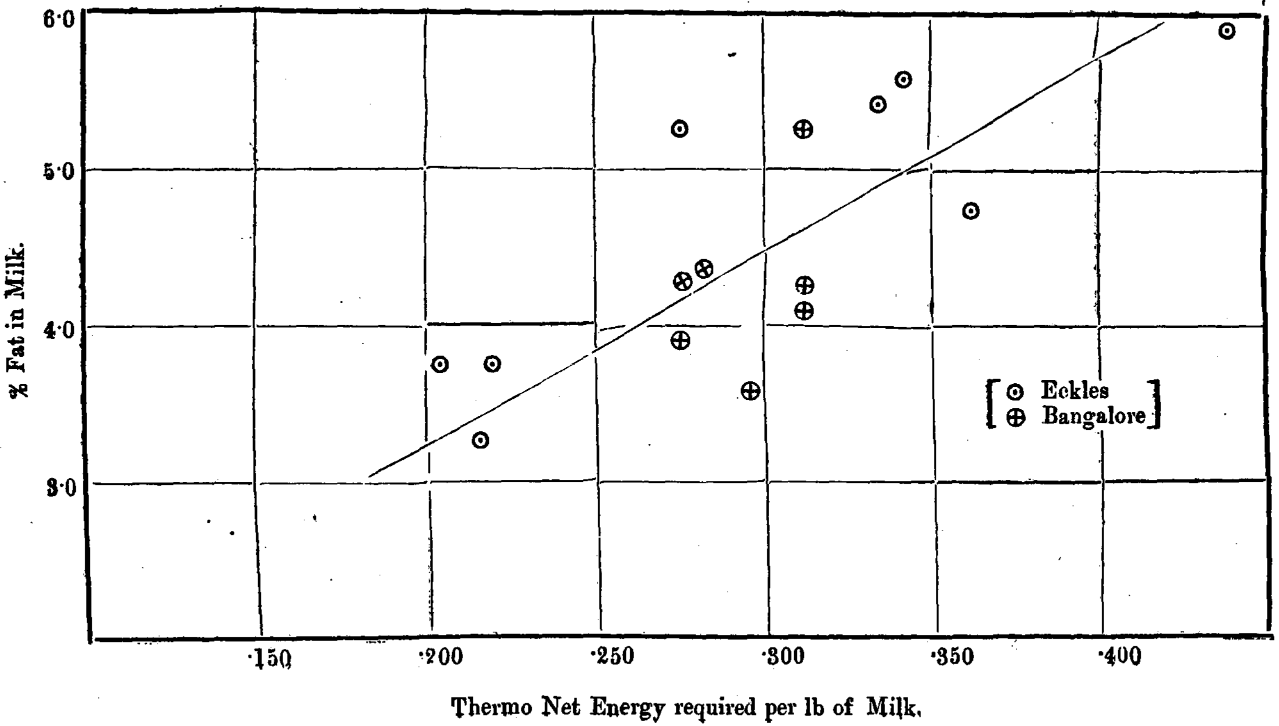
APPENDIX III (*a*).

The Comparison between Bangalore Milk Analyses and American Average figures.



The continuous line represents American figures.

APPENDIX III (*b*).



Replies to the Questionnaire.

QUESTIONS 1 (*a*) AND 4 (*a*).—CO-ORDINATION OF RESEARCH AND ADMINISTRATION.—Considerable changes have taken place in the work of the Agricultural Departments in India during the last few years. The amount of work being done has increased rapidly. The scope of the work has become very much wider. All the Provinces are rapidly providing themselves with facilities in every branch of science which is needed for furthering agricultural research. While the work is increasing the contact between the different Provinces is decreasing. Co-ordination has made no progress. I believe that very great advantages may be obtained by co-ordination and I am in entire agreement with the scheme outlined by Dr. Clouston for bringing about co-ordinated effort. In favour of co-ordination we have the following facts:—

1. However perfect the facilities provided may be, every Province will have features of its own and will be able to help other Provinces in some lines.

2. It is not economical for every Province to work for itself only. There are many enquiries which can be carried out in one place and will yield information applicable to the whole country. For example, the effect of a common foodstuff upon milk production need not be tested independently all over the country. Carefully planned tests carried out at one dairy will yield information for all the dairies.

3. There are questions which cannot be adequately dealt with in one institution. The data required may be so numerous that several institutions must combine together to procure the required information. Some important questions on milk production which will be described later, would come under this category.

4. There are some questions which can be dealt with most economically and conveniently by a Central Institute. The net energy values (Starch Equivalents) of foodstuffs, for example, must be studied at a Central Institute, and the work done there must be arranged by consultation so that the requirements of the different Provinces and tracts are given due weight.

5. Comparative studies of foodstuffs such as the Nutrition Section of the Imperial Department of Agriculture has instituted required co-operation between the Imperial and Provincial Departments of Agriculture. Such comparative work is of the highest importance not only for gauging the potentialities and deficiencies of foodstuffs, but also for determining the capabilities of different breeds of cattle. The Nutrition Section has already noted remarkable differences between Indian and cross-bred cattle in the course of such work. Co-operation with the Provinces is sure to yield more information. This is a class of work in which a Central Institute is essential.

In all these cases we require joint consideration of the problems and a systematic distribution of effort. Other branches of agricultural research should undoubtedly be dealt with in the same way.

Dr. Clouston's scheme for effecting co-ordination.—I would like to make some remarks on Dr. Clouston's proposals.

1. The Advisory Council for Agriculture in India. This Council would function more or less on the lines of the Council in England. It would not be concerned directly with the activities of the Provincial Departments of Agriculture but it would be kept in close touch with the work through provincial representation on the Council and would arrange for the execution of co-ordinated work with the Provinces. The primary duty of the Council would be to keep in touch with the progress of agricultural research through Committees of Experts. The members of the Committees would not be drawn from the Council but each Committee would be adequately represented on the Council. The second function of the Council would be to consider and endorse the recommendations of its committee and to take the necessary steps for having the work carried out. To effect this the Council must be strong and representative. It must also possess ample funds and must be able to call upon the staff of the Imperial Department for assistance.

2. *Institutions under the Government of India.*—Well-staffed and well-equipped specialised institutions under the Central Government are required for carrying out co-ordinated enquiries in co-operation with the Provinces (the functions of the Nutrition Section in this connection have been exemplified above). These institutions may also be called upon to provide experts and expert assistance to the Provinces engaged in co-ordinated work. The present institutions under the Government of India will require considerable expansion to meet these demands. Instead of a Dairy Section and a Nutrition Section larger separate institutions for these subjects are required.

3. *The Committees* nominated by the Council will form the backbone of co-ordinating enterprise. Success in the scheme will depend entirely upon the work done by the committees. They must be given every encouragement and support. I strongly urge the formation of a committee to deal with animal nutrition. The nutrition problems of India are too serious and too diverse to be dealt with as a side issue.

QUESTION 1 (*b*).—Progress in Research on Animal Nutrition is seriously hindered in a number of ways:—

Firstly, there is a lack of facilities in the field. In the study of mineral shortage (to take one example only) it is absolutely essential for the Nutrition Section to carry out feeding tests in selected localities. Such tests could be conducted very easily on farms belonging to the Provinces. The Nutrition Section has carried out one test of this kind at a cost of Rs. 300, the funds being obtained from a special grant. The experiment was carried through without a single hitch and now the Section has received two cordial invitations from Provinces for further experiments of this kind. Unfortunately we cannot undertake this work because it involves the expenditure of money from Central revenues at a provincial farm and the temporary transfer of one or two subordinates from headquarters to a provincial farm. As matters stand at present this constitutes an improper diversion of Central revenues, though actually it is a very economical arrangement. Instead of opening up independent cattle farms the Nutrition Section could co-operate with the Provinces, using their cattle and their foodstuffs free of charge, for the elucidation of nutrition problems which are of vital interest to the whole country. Considering the tremendous economies which this proposal offers, the unnecessary duplication of farms which it avoids and the possibilities it opens up for real progress in Nutrition questions I feel confident that the Government of India will be prepared to sanction work on these lines at once, if it is approved by the Royal Commission. Animal Nutrition in India cannot be studied adequately if the work is confined to a laboratory at headquarters.

In addition to field work in the Provinces some field work is essential at headquarters. The Dairy at Bangalore as at present constituted has no land whatever to spare. In fact there is no room here for two Sections. Either it must be a Dairy Institute or it must be a Nutrition Institute. The space is even cramped for a Dairy Institute alone. The fact that the Dairy purchases a large proportion of its roughage from outside is a sufficiently striking proof of this statement. The place is not ideal for a Nutrition Institute especially as it is under an obligation to provide milk for the troops, but the milk production could be reduced down to the Military requirements and thus the available space of nutrition work would be considerably increased.

Further, important nutrition work on milk production must be undertaken in this country. Much of this work will have to be done in collaboration with other dairies but some of it must be done in a dairy attached to and in the control of the Nutrition Section. The Nutrition Section requires a dairy and the Bangalore dairy suitably modified would meet the requirements. I must make it quite clear here that it is not my wish to obtain this place for the Nutrition Section if the Dairy Section finds it suitable and wishes to retain it. The point is that there is not room for the two Sections here. We are blocking one another on the ground. In other respects too the close juxtaposition is not healthy. The Dairy Section gives a dairy diploma course and relies upon the Nutrition Section for lectures on elementary science, nutrition and dairy chemistry. Needless to say the Nutrition Section gives what it can gladly. We are pleased and we will always be pleased to be able to do anything we can in return for the whole-hearted help we have invariably received from the Dairy Expert. But the fact nevertheless remains that the Dairy Section is incompletely staffed and has to fall back on this Section. The conditions do not make for healthy development.

Another great difficulty to which I have referred in my memorandum is due to the fact that the dairy is run as a commercial concern and is therefore obliged to go in for cross-breeding. The result of this cross-breeding is that there are very few calves available for experimental purposes. The Nutrition Section was transferred to Bangalore because it was believed that we would have an ample supply of animals here. In the case of calves this is not so. There is an ample supply of cows and the Section will very soon be able to commence new work on milk production, but it is not likely that we can do a great deal even on milk production until we have a dairy under our complete control. In this connection it may be recollected that the School of Animal Nutrition at Cambridge recently decided to establish a dairy of its own for carrying out investigations in milk production.

The situation of the Bangalore dairy so far from residential quarters is another great drawback to the work on Animal Nutrition. For efficient work quarters are required here for the entire staff.

In conclusion, I consider that the site would probably be suitable for either of the Sections, but it is not suitable for both together. If it is intended to establish efficient and well equipped Sections for Dairying and Animal Nutrition more space is absolutely essential to allow for the necessary expansion. I would like to suggest the Belgaum dairy as a suitable place. The Military authorities might be prepared to hand it over on terms similar to those under which the Bangalore dairy was transferred.

QUESTION 16.—FODDER AND ITS STORAGE.—*Sorghum* is the most important fodder in India. Broadly speaking there are three types:—

1. Grain *Sorghum* used only for human food. The stems are very thick and cannot be fed to cattle. They are frequently used as fuel.
2. Grain and fodder *Sorghum*. The grain is used as human food. The stover (dry stalks and leaves) is chopped and fed to cattle.
3. Fodder *Sorghum*. This type is grown only for cattle food and is fed green.

We have carried out a few tests with a stover (chopped stalks and leaves) of the second type. Considering the nature of the fodder it is eaten with fair relish and the digestibility is as good as or better than rice straw. For older animals which can eat it in sufficient bulk it is superior to rice straw. The dry fodder is easily preserved in stacks. Tests, carried out by the Nutrition Section, with green *Sorghum* have shown that it is a rich, nutritious and easily digested food. An experiment at Bangalore with very carefully cured *Sorghum* hay, probably the best that has ever been made in India, was not very encouraging. The digestibility was not high. It would appear therefore that hay-making from *Sorghum* is not likely to help agriculture. *Sorghum* silage on the other hand is remarkably good. It has been repeatedly tested at Bangalore and has given excellent results. Silaging fodder *Sorghum* for storage can therefore be recommended strongly. Hay-making does not seem to be satisfactory. However very much more information is required concerning the merits of *Sorghum* stover and hay.

Hay.—At Bangalore we have tested numerous samples of hay from different parts of the country baled, stacked and fresh samples have been examined. Generally the quality has been poor, many samples being less nutritious than rice straw. The causes of this bad quality have not been worked out yet. In some cases it would appear that the soil and climate were at fault. The green plant itself was poor material, containing a very high percentage of silica. The proportion of silica however is not always an index of quality. Rice straw is rich in silica but is moderately digestible nevertheless. In some cases the bad quality was undoubtedly due to late harvesting. Experiments on the question of harvesting are very urgently needed. It is quite possible that in some localities the grass is over-ripe at the time of the rains. It is useless to attempt hay-making in such regions. A better use of the food would be to convert it into silage for local consumption. It is important to find out whether there are areas where good hay can be made.

Preservation of green fodders.—I believe that silage making as an art unknown to indigenous agriculture, can be introduced almost everywhere for preservation of grass and monsoon fodders. Fodder preserved in this form is very easily digested whilst drying fodders in this country seems to lead to reduced digestibility in some cases. I believe Indian agriculture will benefit very materially by the extensive use of silage.

NUTRITION IN RELATION TO BREEDING AND MILK PRODUCTION.—1. More stress should be laid on the fact that provision of good bulls is not sufficient to improve the cattle. Deterioration must be attributed partly to bad feeding. The food-supply should be studied in areas where bulls are introduced.

2. There are some difficulties connected with the feeding of good dairy cattle in India. The ordinary milk mixtures which have been found satisfactory in Europe are too expensive to be used here. It is important to carry out tests with a variety of our economical mixtures over very long periods to determine what effect they have on the cow's life and vitality. Will her useful life be affected materially by such differences in feeding? This question is of very great economical significance. It can only be studied by well organised co-operative tests. The question of mineral supplements for cows is another matter on which the milk yield, the cow's useful life and the vigour of her offspring depend. There are many vague beliefs regarding stimulating foods and foods which tend to hasten drying. Dairymen require assurance on these points. For the dairy industry therefore special nutrition enquiries are needed. In this work the guidance and co-operation of a strong Nutrition Institute are indispensable.

3. *Breeding and milk production in cultivated areas.*—I believe silage would greatly benefit breeding and milk production in cultivated areas. Under normal Indian conditions it is the young calf that suffers most of all. It is put on to hard dry roughage long before it has developed a capacity for such food. In Bangalore the Nutrition Section has observed the fatal effects of feeding average quality Indian hay to calves. They cannot learn to fill themselves and the Net Energy Value of the food consumed is barely sufficient for maintenance. It is useless to add a rich oil-cake to such a ration. On the other hand silage feeding to young calves has given us remarkably good results. It has never failed. Legume hay is also worth considering. I made hay from Phaseolus Mungo in Burma. It was a rich food and was very much relished by cows and young stock. I believe that some legumes containing prussic acid could be converted into perfectly safe and nutritious hay. For example, Phaseolus Lenatus plants contain a very large amount of prussic acid but on drying in sunshine the poison is completely eliminated. Such legume hays would form excellent food for growing cattle.

PASTURE PROBLEMS.—The pasture problem in India is intensely complicated and our knowledge of the different aspects is meagre.

1. *Quality of pasture grasses.*—We distinguish good grasses from poor ones partly by the conditions under which they thrive, that is to say, we assume that the good grasses are those which grow on good ground, but we have no direct evidence that the so-called poorer grasses are not equally nutritious when they occur on good ground. The Nutrition Section working in collaboration with the Bombay Department of Agriculture is attempting to clear up some of these preliminary difficulties. We may also distinguish poor and good grasses from the way they are relished by cattle. Here again it is not likely that the nutritive value is the only factor influencing relish. Taste, smell and presence or absence of hard awns play a part. That cattle are greatly influenced by taste was demonstrated a short time ago in one of our

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Bangalore experiments, in which some of the animals refused to touch a very nutritious soft hay which is eaten with relish by animals brought up on it. The same thing doubtless occurs on pasture land. The animals are eating one kind of grass and it is practically impossible for them to change over to another kind of perfectly good grass even if they are nearly starving. It is by no means impossible that at some future date the question of taste and smell will have to be studied chemically to elucidate our feeding difficulties. The awned grasses such as *Andropogon contortus* are definitely a great nuisance in our pastures and must be classed as bad though the cattle do eat them sometimes. The Nutrition Section is engaged at present in determining the intrinsic values of different pure species and in estimating the effect of environment on these values. The mineral question is receiving attention at the same time. As this work has only just commenced there are no data available.

2. *Improvement of grazing areas.*—Grazing is a process of selection in which the animal consumes the good grasses and leaves the poor grasses. It might be supposed therefore that light grazing would tend to eliminate the good species and favour the poor ones. Carrying the same argument further, close grazing should be less harmful because it would cause a reduction of the poor grasses also and hence less change of herbage should result. Another method of avoiding selective consumption is to mow the grass. In this way all species have an equal chance and the pasture should accordingly improve. These expectations are entirely contradicted by practical experience, which shows that close grazing is generally fatal to pasture land in India, whilst mowing does not bring about any improvement in species. The herbage depends mainly upon the quality of the soil and upon its moisture content. Close grazing reduces the organic matter in the soil (the root system is reduced to begin with) and also the water holding capacity of the soil and the soil moisture, whilst erosion is favoured. The soil becomes poor, the yield of herbage falls and its quality declines. Dr. Burns in Bombay has shown that fencing and protection from overgrazing improve the soil and the herbage. Bunding and regulation of the flow of water may be expected to produce good results also. Cultivation, which has recently yielded such good results in Great Britain, might be tried with advantage, but in making such attempts in India certain precaution would have to be observed. The first effect of cultivation is very often a great stimulation of weeks and a set-back for the grass. Light disc harrowing is most likely to help the grass. I have no practical experience in this matter however. Much better cattle food may be expected from areas of mixed farming, but the close grazed areas are too poor to be cultivated. There are innumerable instances in this country of crop production on the fringe of culturable land. The grass is ploughed up and a meagre crop of *juar* is obtained. Following that we have a useless plot of weeds for a couple of years after which the grass slowly establishes itself again. It seems to me that amelioration of the land might be tried in such areas, by fencing, encouraging grass growth in accordance with Dr. Burns' procedure and control of surface water.

3. *Mineral deficiencies in fodders.*—The Nutrition Section is collecting material from various sources for the study of this important question. The bulk of the work at present consists of chemical analyses of typical samples. One very remarkable result has been obtained in a feeding experiment. A sample of Indian hay supplemented with concentrate gave a negative digestion of minerals. When it is recollected that only a part of the digested mineral matter is retained in the body it becomes clear that we are here in touch with a most serious case of mineral shortage. It is probable that the question of mineral deficiencies is one of the most important nutrition subjects in India.

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Oral Evidence.

A.414. *The Chairman :* Mr. Warth, you are Physiological Chemist in charge of the Animal Nutrition Section in Bangalore?—Yes.

A.415. You have put in a very interesting note for which we are greatly obliged. I have very few questions to ask you. Your note is concerned mainly with technical points. I have no doubt that we shall learn a good deal from our visit to your Institute this afternoon?—I hope to show it to you this afternoon.

A.416. I see that in the early part of your note you point out that there is difficulty at the moment in your making the fullest use of your opportunities for collaboration with the provincial authorities owing to the decision of the Government of India that Central revenues ought not to be spent on provincial institutions?—I would not like to put it quite so definitely as that. I do not know that there has actually been a decision on that point; it has been pointed out to me by the Agricultural Adviser that this would probably not conform with the conditions at present prevailing.

A.417. Has any expenditure suggested by you ever been turned down on that ground?—I wish to do an experiment immediately, and it is being held up on that account.

A.418. So that it would seem in that case that a definite ruling of the kind I have mentioned has been given?—Yes.

A.419. Do you find the Provinces anxious to make use of the help which you are giving them?—I have been cordially invited in two places.

A.420. And you think, to get the best value out of the money expended, that the Government of India would be well advised to allow the Central revenues, under proper safeguards, to be spent in the manner you suggest?—I do, because I consider the work cannot be done unless it is done in those particular places which we select.

A.421. On page 66 an interesting point is raised. You are talking about the difficulty of carrying on research work in a dairy run as a commercial concern. Is it your view that herds or dairies run for the purpose of research are not to be expected to pay their way?—If they are doing research work they cannot pay their way.

A.422. When you come to demonstration, that is a different matter altogether, is it not?—If you are to demonstrate the profitableness of a procedure it must be profitable.

A.423. And it is very important not to attempt to demonstrate on the profit-earning potentialities of an industry at an institute where money is spent on research unless you have your experiments entirely separated?—It would be very difficult to separate them; it might possibly be done.

A.424. Have you had personal experience of propaganda?—I have had no experience of that kind at all.

A.425. I judge from your paper that although you have done a great deal of work already you yourself feel that you are only at the beginning of your labours?—We have only commenced; we have just begun to touch the problem.

A.426. And yet the results which you set down here appear to a layman like myself to indicate great possibilities for the future?—The conditions are so absolutely different in India that we are bound to point out important facts.

A.427. You are really doing entirely original work?—Because the conditions are so different, the work is quite original.

A.428. You are doing some important work in the matter of the nutritional value of various fodders?—Yes.

A.429. How do you envisage that information being placed at the disposal of the cultivator in his village when it is ready for publication?—I envisage all this information as going to the cultivator through the experts who are dealing with cattle, not from me to the cultivator.

A.430. It will be a question of recommending particular fodders?—To the institutions where work on cattle-breeding, cattle-feeding and dairying are proceeding.

A.431. We are accustomed in Great Britain to be advised by experts like yourself as to the proper balanced rations. That is hardly a practical proposition in this country, is it?—With regard to the feeding of cows it is an important matter, especially when they are high milkers; that will be a difficult matter in this country as I have pointed out in my answers.

A.432. But you do think that your work will lead to interesting results in the matter of choice of foodstuffs for cattle. Do you think it likely that your results will suggest that particular cattle are more suitable to particular districts owing to their capacity to digest and make the best use of food produced in those districts?—I cannot say; it is possible.

A.433. You are very emphatic as to the value of silage and as to the practicability of successful propaganda in the direction of spreading the practice of making silage?—Because our results have been so very satisfactory with it; they have been altogether satisfactory; it is easy and cheap and good and sure. It cannot be burnt of course.

A.434. Is it spreading at all to your knowledge?—I believe all the Provincial Governments are doing their best to push it forward.

A.435. Of course to the uninitiated mind it looks so improbable as a process until you see it done that it is difficult for them to believe that it is practical?—Yes, it is so.

A.436. I take it the only hope of persuading the cultivator to adopt it is to give him a demonstration under the conditions with which he is familiar? —Yes, and the demonstration is so easy.

A.437. On page 64, you give the Commission your views as to the merits of Dr. Clouston's proposals for the co-ordination of research work in general in India. Have you any ideas of your own other than those which you have set down in your note of evidence as to the constitution of a central body which might be set up?—I have not gone into the details at all. My object in writing this was to give an example of how extremely useful such a scheme would be as applied to the work of animal nutrition and suggesting that in all probability it would be equally useful in other directions.

A.438. I see that like Mr. Smith you are of opinion that sooner or later a separate herd at a separate institution will be required for your work alone, apart from the dairying and cattle-improvement work?—The point is that the place we have will not contain us both; we are at the limit; we are in fact stepping on each other as it is.

A.439. Would you rather go to a distance with an entirely new institution or would you rather have an extension here?—I am afraid the question of extension here would be found to be impossible. There is simply no land available, and therefore it cannot be considered. I am afraid that is the case.

A.440. It does seem at first sight that contiguity as between the work being carried on by Mr. Smith and the work immediately under yourself would be an advantage in the matter of teaching?—It is a most unfortunate thing; I regret it; but the place will not admit of it.

A.441. You and your staff are doing a certain amount of teaching?—We are doing what we can; I do not think that the teaching that we are doing for Mr. Smith's section is of such a high standard that it could not be done very easily by his own people if he had more staff. That I consider a trifling matter. There are other matters where contiguity would be useful in combined efforts; that is mainly what we would be losing.

A.442. Do you not think that in the future the teaching side of your work will necessarily increase?—I consider that the main increase I may expect is in the matter of post-graduate students, not in direct teaching of junior students.

A.443. So I should expect; so that having that in mind, you see no reason why post-graduate training in your work should not be carried on at a separate institute?—Quite easily.

A.444. Are there any signs that greater interest is being taken in teaching animal physiology?—I cannot say.

A.445. Are you having any applications at all from graduates?—We train about a man or two a year, mainly men who are going in for dairying. We have at present a man under training, a qualified man in other ways, who is going to take up the work of animal nutrition in the Madras Presidency.

A.446. Are there other openings in India for the type of physiological chemist whom you would train as a post-graduate learner?—At present, none. I think the work of animal nutrition must increase throughout the country, and if that were so, we would probably have the duty of training men for the posts.

A.447. Do you think that the teaching side has an important reaction on the research side in the case of your own work?—It is no drawback whatever; it is probably a help and an inspiration.

A.448. I do not know whether there are any other observations of a general nature that you would care to make before I ask my colleagues to put questions to you?—I have nothing to say.

A.449. *Sir Ganga Ram:* Have you published any pamphlet naming the different fodders on which you have made experiments, and the results?—We are slowly publishing the work that we are producing, but we have not got very far with the work of publication at present.

A.450. I only want to know the names of the different fodders on which you have made experiments?—We have recently done a large number of experiments on samples of hay produced in this country.

A.451. What do you mean by hay?—I mean grass duly cured to make it into hay.

A.452. Not wheat straw?—No. We are about to test wheat straw; we are about to carry on a long experiment on wheat straw.

A.453. And gram straw?—We have not done that.

A.454. Have you made any experiments on *senji*?—No.

A.455. Do you know what *senji* is?—I do not.

A.456. Mr. Smith probably knows about it. In the Punjab it is largely given to milch cattle; we call it *senji*?—We would like to test it. There is a tremendous task before us of testing innumerable foodstuffs; we know nothing about them at present.

A.457. What is the meaning of "roughage"?—All foodstuffs which are bulky and not highly nutritious.

A.458. It is not a mixture of straw and cake and that sort of thing, is it? —Well, the cake is a concentrate, but straw is the roughage.

A.459. You say there is a mineral shortage. Do you mean salt? Or what? —Recent work in England has shown that many foodstuffs are short of lime, phosphoric acid, and minerals of that kind. We believe there are severe shortages of these essential minerals in various parts of the country.

A.460. Lime, phosphoric acid and what else?—I am afraid I said "and various other minerals." It may be sodium and chlorine.

A.461. And salt?—Yes, and salt.

A.462. *Sir Thomas Middleton:* You have just told us that your main work at present is investigating the quality of food materials?—Yes.

A.463. You have got, I assume, a pretty good knowledge of the composition of the grain of India?—I had to select what work seemed most essential and it appeared that we know more about the grain crops than about the coarse foods, so that I have specialised in coarse foods.

A.464. There have been a large number of analyses of the main food grains of India, but the coarse fodders have never been investigated?—That is so.

A.465. How are you dealing with the problem of the quality of the coarse fodders? First of all is there a chemical analysis?—We carry out chemical analysis in these, combined with digestion experiments and long or short period feeding tests, in fact as big a test as we can with the material available.

A.466. You do carry out digestion experiments here?—Yes; we do not consider we have carried out anything at all unless we have carried out digestion experiments.

A.467. Supposing you take one material such as *Sorghum* fodder grown and harvested under various conditions in India, do you find very wide difference in the digestibility of the samples of *Sorghum*?—That is an important piece of work which remains to be done; we know nothing about that.

A.468. You are at present concerned with the types and not the variations?—Yes.

A.469. Could you give an indication of how many types of grasses you have had under investigation? You have investigated mixed herbage, but I suppose you have also been dealing with individual species?—For feeding tests we have not carried out a single test for absolutely pure herbage yet except perhaps *dhub* grass. That was probably almost pure. We have also tested Rhodes grass.

A.470. Have you tested guinea grass?—Guinea grass we have not actually tested, though it is on the farm. The other fodders were mixed herbage as found in various areas.

A.471. *Sir Ganga Ram:* Have you published any pamphlets on these two grasses?—I have not.

A.472. Where can we get them?—We are not quite ready to publish these things yet; we are collecting the information.

A.473. *Sir Thomas Middleton:* So that you are not able to verify the Indian cultivator's opinion of his several species; you judge from an examination of the mixed species in hay, and can only form a rough idea of the relative quality of the grass contained in the hay?—That is so. But the work is only beginning; that is really the point. I cannot speak with certainty about any of those matters.

A.474. Now, coming from the food materials to the needs of the animal, are you doing any independent work to ascertain the needs of the Indian animal as distinguished from the needs of those that have been worked out in other countries; *e.g.*, do you adopt the usual standards provided for the milch cow in Europe and America as a basis for the standards in use in Bangalore or have you investigated the needs of the Indian cow independently?—We have studied the effect of feeding cows in India with the standards adopted in America; we have to use American standards because they apply more to our foodstuffs than the European standards. We have found the cows very economical in the use of this particular standard. I cannot say more than that at present.

A.475. *Professor Gangulee:* The Armsby standard?—The Armsby and the Henry and Morris, or both.

A.476. *Sir Thomas Middleton:* You have been using American standards. Are you using the bomb calorimeter in your work?—We have done no calorimetric work. I admit it is an urgency; but we have got to build up these things.

A.477. Whereas the standards required for milk production have been pretty fully worked out in other countries, we are still very ignorant of the animal's needs for work production; especially as such standards as exist have been worked out for the horse. Has any attention been given in India to the needs of the working bullock as distinguished from the milking cow?—Actually some work has been done; but we have not got good figures at present. I see no way of attempting that problem immediately.

A.478. It is a very difficult problem?—But we have considered it, and we have got plans partly prepared for doing work.

A.479. Would you say in the case of the working animal as in the case of the milking animal, that the Indian animal is economical in its needs?—I have found the Indian bullock extremely efficient in digestion; I can say nothing more than that.

A.480. The Government of India supplied a memorandum to the Civil Research Committee last year on the question of mineral deficiency in pasture. Did you take part in the preparation of that memorandum?—No; I had no information to give. But we have since then made a little progress, but there is very little progress to record.

A.481. That explains your answer to Sir Ganga Ram?—Yes.

A.482. Could you be more specific; could you indicate to me any districts in which there are indications of mineral deficiency?—I suspect one district, but I would rather not say anything definite at present.

A.483. Have any cases of iodine deficiency come to your notice?—No.

A.484. You make a suggestion in your memorandum about the possibility of adopting a method that has given good results in Great Britain recently in improving our poor grass land. Are you referring to Professor Stapledon's writings?—Well, actually when I wrote that I was thinking of some of the work they have done in Wales.

A.485. That is Professor Stapledon's work?—Yes.

A.486. You must recognise that Wales has a climate which is peculiarly suitable for this method of improving pasture land. I personally should doubt very much whether it would be likely to succeed under Indian conditions?—I am not prepared to say anything on the subject except as a suggestion.

A.487. *Dr. Hyder:* There is some post-graduate teaching done here under your direction?—I have had students during the last three years.

A.488. And you are not satisfied with the standard of knowledge of chemistry with which these people are equipped?—It depends on what work they are to do when they leave me; if they are to be cattle-breeders or cattle experts, I consider that I have shown them something about the value of foodstuffs which will be useful to them; if they are supposed to go back to their Province and take up the study of animal nutrition, I say they cannot do it.

A.489. Let me go into the question of the relation of Indian Universities to the instruction given by you. You know that we have the B.Sc. and the M.Sc. In the B.Sc. you must have either chemistry or physics and one more subject. In the M.Sc. you need have only one subject, chemistry for example. In the Honours course there is a thorough grounding in chemistry, and one or two subsidiary subjects, *i.e.*, to test the knowledge of the student in English and in another subject like that. I cannot make discrimination between the Universities, but take the M.Sc. or the Honours standard. Do you think a man who takes an Indian M.Sc. degree in chemistry would be able to carry on such researches as you are carrying on after he has passed through a course of training given by you?—I see absolutely no reason why he should not; there is no reason at all. I should say that he has undergone a training which will fit him for the work. It depends upon the man entirely; I think he would be perfectly able to do it; there is no reason why he should not be able to do it under those conditions.

A.490. For the proper development of post-graduate teaching here so that these people might become dairy experts or might carry on research such as you are carrying on, would you insist upon either an Honours degree in chemistry or an M.Sc. degree?—It depends upon his future work. If he is to do this class of work then he must have a high training in chemistry or the allied work that he proposed to take up; if he is going to be more on the agricultural side, that is not necessary.

A.491. That, of course, would be a waste, if he went to the agricultural side and gave up the special training which he has received?—If he is going to be a cattle expert, he really ought to be a cattle expert even when he comes to me; an Honours degree in chemistry is not required for that part of the work; but if he is going to take up the study of nutrition, then he must possess chemical knowledge.

A.492. Our object is to aim at the production of bio-chemists attached to different institutes in different Provinces of India. I personally consider that it would be a waste of your time and resources if these people went over and became cattle experts?—I should say that they would have had one kind of education and were going to try to do something else.

A.493. There are no other bio-chemists attached either to the Indian Universities or attached to departments of Provincial Governments?—There is nutrition work being carried out; very useful nutrition work is being carried out at Lyallpur by the Agricultural Chemist there.

A.494. *Sir James MacKenna.:* What do you consider to be the most important All-India problem in animal nutrition which is facing us at present? —I think the mineral deficiency in our foodstuffs is the most important All-India problem.

A.495. Have you taken it up yet?—We tried to take it up.

A.496. What are the difficulties in getting on with that?—It is again this question that we have just had before us; I cannot do the test at the place where it is essential that the test should be done.

A.497. That brings you up against the Devolution Rules?—Yes, the Devolution Rules are hindering this work which, I must say, is the most important question.

A.498. Until you have free access to the Provinces and the right to spend money in the Provinces, you cannot get on with this very important All-India question?—No, I cannot.

A.499. You are doing a certain amount of work on fodder crops?—Yes.

A.500. Have you any facilities here for testing fodder crops?—There is no room at the dairy, as I have already pointed out, and it is absolutely essential that I should grow crops for testing. I cannot grow any crops for testing.

A.501. Can you give us any rough idea of the equipment and the staff necessary to make your section self-contained and adequate to tackle the problems you have in front of you?—Well, just to deal with this one single point I consider I require 100 acres of land for fodder crops.

A.502. What staff do you require?—The farm staff to deal with that.

A.503. That is a matter of detail?—Yes, I have not considered it.

A.504. That is a matter for you to fight out with the Government of India?—Yes.

A.505. *Professor Gangulee:* For the investigation of mineral deficiency, you could not get adequate laboratory facilities?—Our laboratory is very small, as you will see this afternoon. We can do a fair amount of work in it; we are not really afraid of that; but the chemical analysis of foodstuffs does not give the necessary information. You must test it on the animal and you must test it on the animal at the place where it is produced. That is our trouble.

A.506. And for that you have not got sufficient funds?—It is not so much the funds; it is the procedure which is illegitimate almost, you may say, for us to follow at present. We have not the right to work at the places where we want to carry out this work.

A.507. Your expenses are another question; the question is that you have not the proper facilities for carrying on the work?—Expense is a small thing, but of course it is a factor which prevents us from working; we are not allowed to expend the money for that object in the Province.

A.508. You say in your memorandum that you took up this duty of training these post-graduate students voluntarily; was that without any direction from the Central Government?—If you wish me to lay stress on that, I more or less insisted on doing it, when it was perhaps objected to.

A.509. You felt the necessity of having post-graduate students?—I wished to have them.

A.510. And without any direction from the Central Government?—Not in the first place, no; I asked for it, and then I was allowed.

A.511. About 7 students have already completed the course?—Yes, about 7.

A.512. Could you tell us how they are being employed now?—One of the students is Assistant Professor of Agriculture in the Punjab; two, I believe, are Deputy Directors in the Punjab; one is the Manager of the dairy at Nagpur.

A.513. It is rather gratifying to see that you hold a very high opinion of those who actually took the course?—They were selected men who were sent to me, and I found them very nice and agreeable men.

A. 514. And yet you say definitely that these men were not fit for higher posts?—I said they were not trained for taking up the work of animal nutrition. I think I gave you that reply.

A.515. *Dr. Hyder:* May I make that clear? If you had a first class or second class M.Sc. of an Indian University and he received training under you, would you say that such a man was fit or not fit for a first class post?—I say that there is no reason whatever to suppose that he would not be fit.

A.516. *Professor Gangulee:* What are the qualifications of these men that you have trained?—I specified them in my memorandum. I cannot say exactly now what it was. They had not specialised in the important and necessary subject.

A.517. Referring to your own research, you have made a very good beginning in the investigation of some of these fundamental problems of animal nutrition. Have your investigations attracted the attention of the Provincial Departments of Agriculture?—I do not think the Provincial Departments of Agriculture are really at present aware of what work has been done. We have not been able to publish very much so far.

A.518. You say, I think, in your printed memorandum that the Military dairy farms took up the question, and they came to you for advice and direction, and also that you started co-operative experiments in the Provinces of Madras, Bombay and so on?—That is so.

A.519. They were attracted by your work?—Perhaps we went to them; they did not come to us. We cannot say that the work has made any great impression on the country, because it has just commenced.

A.520. You do a considerable amount of advisory work, I see here, for the provincial departments?—We answer questions occasionally. I consider we have not done very much in that direction.

A.521. Do these Provincial Livestock Experts pay occasional visits to Bangalore in order to study these various lines of investigation?—No, they do not.

A.522. The most important experiment to my mind is your digestion experiment, and you have obtained the co-efficients which enable you to estimate the digestibility of cattle fodder and cattle foods. Now, are you undertaking a study of the relative values of Indian fodder and feeding stuffs?—At present, we are studying the relative value of all fodders by co-ordinated long-period feeding tests, and seeing how much fodder is practically required to maintain animals. That is the way we are comparing them at present; it is not a very accurate method; when we have more means, we will institute more accurate procedures.

A.523. But, nevertheless, this work is so important that the Provincial Livestock Experts ought to be interested; do you mean to say that they are not interested?—Again, I say we have worked here for 2½ years only. Before a year and a half was over, we could not publish anything; we have now commenced to publish. People are perhaps beginning to know that we exist, and we hope to have a great deal of contact with these people later on.

A.524. You have published articles in the *Agricultural Journal of India* which I read with great interest?—I have published two articles in the Journal and two memoirs so far; it is merely a fraction of what we have to do.

A.525. You mention here that feeding tests may be carried out in any part of the country. Do you receive any requests from the Provincial Agricultural Departments for the purposes of such tests?—Fortunately, we have the Imperial Dairy Expert's farm at Karnal, which is always open to me, as everything of his is generously open for work; and we have carried out experiments there many miles from our headquarters; we have actually commenced another experiment this year.

A.526. So that, in view of this, shall I say, apathy of the Provincial Governments, you feel that co-ordination of some sort is necessary?—I do not wish to say that the Provincial Governments or the Provincial Departments are apathetic in the least. I do say that co-ordination is very important. I have pointed out the ways in which co-ordination will help the work, and I think of course the means must be provided for carrying out this co-ordinated work.

A.527. Do you think that the existing organisation is inefficient to bring about that co-ordination which you desire?—From my note, you will see that I consider it is inadequate, and I consider that the provision of these facilities for co-ordination will yield very good results as far as the nutrition of animals is concerned, and I believe they would act beneficially in other branches of research also.

A.528. Would you like to have an Advisory Council, functioning on the same lines as the Council does in England?—Yes; it would be advisory, with the proviso that there are acting committees under it.

A.529. No executive authority would be given to this Council?—It is hardly for me to make recommendations of that kind. If we give executive power, it would be all the better.

A.530. I raise this point because you say here " would arrange for the execution of co-ordinated work." That suggests that you are looking for executive authority vested in this Council. Do you think the Board of Agriculture is functioning in that direction as an Advisory Council?—Yes, for the purposes which we are thinking of; in co-ordinating work we want something stronger, and provided with funds and power for carrying out co-ordinated work.

A.531. Then you will not be satisfied merely with an advisory function?—I think it must be mainly advisory.

A.532. With regard to your *Sorghum* silage, what type of silage have you evolved? Have you evolved any particular form?—No particular form; I have just tested the ordinary *Sorghum* silage here.

A.533. Would your method be expensive for the farmers?—The cutting is an expensive item.

A.534. *Dr. Hyder :* I was wondering whether you, as Physiological Chemist, were also considering the question of the best method of preservation of the vitamin contents of such fodder, so that the vitamin contents of the milk and other produce may be preserved and increased?—There are many important questions which we would like to tackle, but cannot do so.

A.535. *Mr. Kamat:* On page 59 of your memorandum you say that the cross-breeding principles on which milk production at Bangalore is based are an endless trouble to the Nutrition Section. You also say there that the dairy only wants to have half-bred cows, and that their offspring is a useless mongrel, which they must sell. Do I take it that you disagree with this principle which the Bangalore dairy is following?—Not at all. The only thing is that it does not help me in getting the cattle I require for experimental purposes. They do not keep their calves because they are not very valuable to them, and we have not got as many animals as we would like for experimental purposes. I have no criticism whatever to make with regard to the principle of cross-breeding.

A.536. So that, the complaint is only from the point of view of the experimental work?—That is all.

A.537. Not from the point of view of breeding or milk production?—Certainly not; I could not possibly criticise it.

A.538. And then the remedy you suggest at the end of that paragraph is to put the dairy on an experimental basis, which would enable it to breed and select animals. Will you please explain what that means?—If the dairy were breeding country stock, they would not mind keeping all the young animals, and I would thus have more young stock to work with.

A.539. You agree that this policy of selling the offspring from the cross-bred cows is the right one, which even private cultivators can follow?—I have nothing to do with that subject whatever.

A.540. You do not wish to express an opinion on it?—It does not concern me; I would rather not.

A.541. *Sir Ganga Ram :* What propaganda do you employ now to teach the agriculturists the value of your labours?—In answer to the Chairman I explained that I propose that all the results we obtain should be made known through the Agricultural Departments and not from me direct.

A.542. It has not been done so far in any shape or form?—No; I would rather not do that; I am not in contact with the agriculturist. I am doing experimental work, and I would make it known to the Agricultural Departments.

A.543. Are your reports secret?—Certainly not.

A.544. Is there any publication of these reports?—There is the annual report to be had, and there are other publications that we make, in the form of bulletins, or memoirs, or any articles in the agricultural journals.

A.545. Is yours the only Institute of Animal Nutrition in India, or are there any others?—There is an institute in the Punjab, which I mentioned, where work on animal nutrition is being done to a small extent.

A.546. Is that a subject of the College?—It is one of the experimental subjects.

A.547. Who is doing that?—Dr. Lander, Agricultural Chemist to the Government of the Punjab.

A.548. *The Chairman :* You would agree with me that the scientist who rushes into print before his results are ready for publication is rather apt to find that his reputation goes up like the rocket and comes down like the stick?—I agree with you.

(The witness withdrew.)

The Commission then adjourned till 4 p.m. on Thursday, the 11th November, 1926, when Mr. N. Rama Rao, Sericulture Expert with the Government of Mysore, was examined. It then proceeded to take evidence at Coimbatore from 13th to 16th November, 1926. For the evidence of Mr. N. Rama Rao and the first 6 witnesses (provincial) at Coimbatore see Volume III. The last witness to be examined at Coimbatore was Rao Sahib T. S. Venkatraman (Imperial) whose evidence follows.

Tuesday, November 16th, 1926.

COIMBATORE.

PRESENT :

The MARQUESS OF LINLITHGOW, D.L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.	Mr. H. CALVERT, C.I.E., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.	Raja Sri KRISHNA CHANDRA GAJAPATI NARAYANA DEO of Parlakimedi.
Rai Bahadur Sir GANGA RAM, Kt., C.I.E., M.V.O.	Professor N. GANGULEE.
Sir JAMES MACKENNA, Kt., C.I.E., I.C.S.	Dr. L. K. HYDER.
	Mr. B. S. KAMAT.

Dewan Bahadur T. RAGHAVAYYA PANTULU GARU.
Rao Bahadur B. MUNISWAMI NAYUDU GARU. } (*Co-opted Members.*)

Mr. J. A. MADAN, I.C.S.
Mr. F. W. H. SMITH. } (*Joint Secretaries.*)

Rao Sahib T. S. VENKATRAMAN, B.A., I.A.S., Government Sugarcane Expert, Coimbatore.

Replies to the Questionnaire.

QUESTION 1 (*b*).—One obstacle to the realisation of the maximum benefit from the sugarcane breeding work at Coimbatore is the non-availability of sub-stations in the main sugarcane provinces of the country under the direct control of the Coimbatore station.

The Coimbatore station is intended to produce, by breeding, improved types of seedling canes for every part of India. There are three essential requisites for the proper discharge of this function by the station : first, the actual production of the improved cane seedlings; second, the careful testing of the improved types with the indigenous kinds with a view to selection; and third, the distribution of the new canes to the cultivators.

Over 80 per cent of the Indian area under sugarcane is in sub-tropical India, where the canes do not generally flower, or even if they do, do not set seed. The breeding of canes for the whole of this region has, at present, to be done at Coimbatore in South India. The station at Coimbatore is now in a position to raise any number of seedlings and with most of the desired parentages. It may now, therefore, be assumed that there are no very serious difficulties as regards the first requisite.

The second requisite, *viz.*, the testing of the new canes in comparison with the local kinds and their selection, is at present done in two stages. The leading indigenous canes of Northern India are now acclimatised at Coimbatore and the new productions are compared with the indigenous kinds at Coimbatore itself and a preliminary selection made, of such as are distinctly superior to the indigenous varieties. This first selection at Coimbatore is made none too rigid, through fear of losing any that might ultimately prove useful, when actually grown in Northern India.

R. S. T. S. Venkatraman.

The second, and by far the more important selection, has to be made in the locality itself and this is, at present, done in the Provincial Government firms. Experience shows that these testing stations could be divided into at least three different groups according to the manner in which the selection work is carried on.

We have, first, the class of stations which have an intimate knowledge of local conditions, know exactly which sort of cane will be an improvement on the canes in the locality,—are keen about the trial and spread of the new canes in the locality and are, therefore, only too eager to take full advantage of the Coimbatore work. Such stations render all possible help to Coimbatore in gathering complete data on the good and bad points of the new canes.

The second group comprises stations which are willing to do all they can to test and spread the new canes but are unable to do so for a variety of reasons, such as lack of adequate staff, time or space for properly carrying out the tests, or inadequate facilities for getting an intimate knowledge of the canes in cultivation in the locality. In some of these, the cane is one among the many crops needing the attention of the staff employed, with the result that it does not receive adequate attention.

. There is a third group of stations which, for certain reasons, are not very keen about the Coimbatore canes.

There is thus seen to be a considerable amount of difference both in methods and in the standards adopted, by the various testing stations. When it is remembered, that the testing in the Provinces is the more important test in the selection of the improved seedlings, the disadvantage of the present arrangement would be obvious.

The remedy for the present state of affairs lies, in the opening of substations in every major cane tract under the control of the Coimbatore station by the Imperial Department of Agriculture. The sub-station would be needed for each cane tract irrespective of the political boundaries as to Provinces. These sub-stations would carry the work a step further forward, *i.e.*, to the end of selection of the seedling for the locality and up to the distribution of the cane to the cultivators in the tract, which latter activity is best left to the Provincial Department of Agriculture.

There would be another very important advantage resulting from the founding of the sub-stations mentioned above. For the breeding work at Coimbatore to be carried on at its best, a considerable amount of knowledge is needed about the conditions of growth obtaining in the locality and a personal touch with the improved seedlings as they spread into cultivation. The founding of the sub-stations will secure both these conditions. Sugarcane is, generally, a paying crop and, if properly run, the testing station should be able to remit back as receipts, a fair portion of the monies expended on it. The sub-stations would be in a position not only to recommend the Coimbatore seedlings most suitable for the locality but supply besides a fair amount of material of the recommended seedling.

The proposed sub-stations should seek the full patronage and support of the provincial departments, because the satisfactory working of the sub-stations would depend a great deal upon the hearty co-operation between these and the Agricultural Department in the Province.

Question 3 (*d*).—A striking instance of effective demonstration and propaganda is afforded by the work of the Sugar Bureau at Pusa in spreading into Bihar the improved Coimbatore canes. The Bihar work has further been partly responsible for attracting the attention of certain of the other Provinces to the merits of the Coimbatore productions.

The main feature in the work was the large scale tests which were carried out in the fields of the planters themselves. Besides being on a large scale, the tests were complete and based on results obtained by passing a full and sufficient quantity of cane through the factory and comparing the improved cane with the local variety in all its aspects from the sowing to the obtainment of the finished product in the form of sugar. The thoroughness of the tests readily carried conviction to the planters who quickly adopted the new canes.

When the cultivator sees a demonstrated crop in a Government farm, he sees along with it costly machinery and other equipments—though these may be there purely for experimental purposes—and leaves the farm with a shrewd suspicion that the good results have resulted from other causes besides the ones mentioned. On the other hand, if he notices an appreciable difference in favour of a new variety in his own land and with cultural operations carried out by himself he readily takes up the improved strain.

Two other contributory factors to the success of the Pusa work have been (I) the presence in the locality of an enlightened set of planters who had given up the indigo crop and were eagerly on the look out for another to replace it and (2) the personal keenness of Mr. Sayer, the officer in charge, in pushing the new Coimbatore canes into cultivation.

Enlightened planters like those in the white sugar belt of Bihar are not generally available elsewhere. It is my experience, however, that the ordinary cultivator is not quite as conservative as he is at times represented to be. Once he sees a good thing and sees it in a manner which readily carries conviction to him, he sometimes goes even beyond the limits demanded by caution. I have had such experiences in connection with the improved Coimbatore seedlings.

QUESTION 4 (*a*).—A greater co-ordination of agricultural research in the Provinces, than is available at present, is desirable. I have known instances of experiments started in a Province, without any idea of the results as obtained from the same experiment elsewhere. I am not against the same experiment being conducted in more than one Province. The variations in climatic and other factors, that are found within a continental country like India, render such experiments useful and desirable; a greater touch between the workers will conduce to greater efficiency and quicker results.

With the steady advance that is being made in the direction of provincial autonomy, the Provinces are likely not to support, if not to resent, any central organisation other than of a purely advisory character. To be useful, any central organisation should be so developed as not to suggest any idea of domination or dictation to the Provinces in the matter of agricultural research. With the Reforms the situation needs a rather delicate handling. Facilities for a more frequent meeting in conference of experts working on the same subject, and a small central board consisting of experts as well as of the leading interests in agriculture and allied industries, might meet the situation. The touchiness of the provincial departments should be satisfied by including in the board senior men from the Provinces as well. Such a board need not necessarily involve much additional expenditure, as the members could be made to serve in an honorary capacity. This board could periodically get the programmes of work from the various Provinces and might function both for co-ordinating research and for offering advice on matters of importance.

(*b*) The department under the Central Government should be so developed as to carry a full complement of expert staff in all the branches of agricultural science. It is true Agriculture is a Transferred subject in the Provinces and rightly so after the Reforms. Many of the problems dealt with in the Provinces are best studied in the localities themselves. The scientific officers in the Provinces are apt to be pre-occupied with local needs and work with a view to comparatively quick results. Research into the fundamentals of the problems involved is best tackled by a central department.

There are certain problems such as " The Indian Sugar Problem " and the rather important work of " Plant Introduction " which are best handled by the department under the Central Government.

The data here given would show that the improvement of sugarcane varieties in India could not have been done efficiently by any agency other than a central department. Some of the poorest canes in India are those found in the unirrigated tracts of the Punjab and the largest cane area in India is in the United Provinces. The sugarcane does not flower in either of these regions but does so freely in the Madras Presidency in South India; and, in this Province the cane occupies but a subordinate place among the crops of the locality. The regions most to benefit from cane breeding are thus precluded from undertaking any work in this direction; whereas, the Province in which the cane flowers freely, would not feel justified in going in for any large expenditure on the crop. If the Central Government had not started the Coimbatore Sugarcane Breeding Station, it is difficult to see how else the improved seedling canes for the Punjab, the United Provinces and Bihar would have been secured; very likely the work would not have been undertaken.

The Central Department, while primarily intended for the country as a whole, should be able to bring its superior resources to bear on any particular problem which might have become suddenly urgent and important in any of the Provinces. Any existing indifference of the Provinces towards the central department would disappear after a few definite demonstrations of help and co-operation to the Provinces as indicated above.

It is purely an accident that Pusa in Bihar happens to be the headquarters of most of the agricultural research work under the Central Government. There are certain problems which are better studied in localities other than Pusa. When such a problem arises, the central department should be able to found a station in the Province and carry work on its own account. The location of the Imperial Sugarcane Breeding Station at Coimbatore is a striking example of the usefulness of such an expansion.

(*c*) (*i*) The services rendered by the Indian Agricultural Service are satisfactory, though capable of improvement in sundry directions. The recent Indianisation of the service—that has followed from the recommendations of the Lee Commission—has not in my opinion detracted from its efficiency.

Indians in the department have at the start relatively more difficulties to contend with. For one thing their work takes longer time for getting recognition in the country. I know of instances, where such work received recognition outside the country earlier than within it. So long as the Indian recruit is properly and carefully selected, there need be no fear of loss of efficiency.

It is hardly six years since anything like an effective Indianisation was initiated and that too in but a few of the Provinces. To condemn this policy as leading to inefficiency within such a short period is totally premature. Even new sugarcane seedlings need a longer time to judge of them with any claims to accuracy.

Greater opportunities should be given to the officers of the department to see work elsewhere both within the country and outside of it by affording such facilities as deputation and study leave.

Any foreign training needed for recruits into the Indian Agricultural Service is best given after some service within the country. This would enable the individual to get a good grip on the problems that he will be faced with after his return to the country. The Indian Universities are rapidly developing in equipment and efficiency and the need for foreign training would steadily disappear with the advance of time.

The short-term system of recruitment is not of general utility in the case of the Agricultural Department. It would involve greater expenditure to the State without compensating advantages. Its use is confined to cases where a costly specialist has to be employed in connection with problems which are capable of solution in a comparatively short period of time. The problems presented to the agricultural researcher often need a long period of attack for their proper solution.

QUESTION 9 (*a*) (*i*) AND (*ii*).—With the progress in breeding, a new line of work would appear to have opened out in connection with the reclamation of waste or alkali lands. A sugarcane seedling obtained at Coimbatore by hybridisation with a wild grass, has shown a marked capacity to grow under adverse soil conditions; the ability has apparently been derived from the wild ancestor.

The reclamation of waste and alkali lands could now proceed from two directions; one, by acting on the soil and second, by breeding a strain which would grow under adverse soil conditions. Certain root studies by the writer have shown a definite promise in this direction. Once a barren land gets accustomed to vegetation, of however poor a quality, it would appear to be easier later on to accustom the land to more remunerative cropping.

QUESTION 11 (*a*) (*i*). I would urge the appointment of crop specialists in the case of the more important crops in the country. It is only at the hands of such a specialist that the crop would get the attention it needs. The pure scientists have often a tendency to look at the crop piecemeal and from the view point of their own science. The crop needs to be studied as a whole for rapid progress in its improvement under cultivation.

(*c*). A striking example of successful crop improvement through breeding is afforded by the work of the Sugarcane Breeding Station at Coimbatore. This day and within about a dozen years after its founding by the Central Government, its productions are rapidly spreading into cultivation in every Province to which they have been distributed. The published departmental reports are replete with references to their merits.

I have made an attempt, to obtain from the District Officers, an idea of the increased money value resulting from the spread of the improved Coimbatore canes in place of the indigenous varieties. The figures for the last season are :—

(1) An increased profit of a lakh and a quarter of rupees in Bihar.

(2) A lakh in one circle in the Punjab.

(3) A third of a lakh in one circle of the United Provinces.

It is just nearing four years since the Coimbatore canes got into cultivation and the above figures are bound to increase very rapidly with the advance of time.

One of the Coimbatore productions—Co. 281—has shown " extremely favourable results both as regards tonnage and sugar contents " in Cuba. It is said to have stood " easily the first in sugar " and " very high in tonnage ". It is thus possible that, as time advances, the utility of the Coimbatore work may extend beyond the limits of the country.

QUESTION 13 (*i*). The Act now in force against the importation of sugarcanes from foreign countries is fairly adequate, though there exist possibilities of evading the Act in sundry ways. A quarantine station, for receiving new introductions and growing them for a period under strict control before passing them into cultivation or for breeding, is likely to be needed in the near future. Most of the other cane countries of the world now possess such a station.

(*ii*). The breeding of disease resistant strains opens out a new, efficient and promising line of work for protecting crops against infection from any particular disease.

QUESTION 17 (*d*). The Indian Sugar Committee recommend the starting of a model sugar factory by Government in a suitable place (*vide* page 330 of their Report). At present Indian capital is rather shy of investment in sugar concerns. The establishment of a Government factory, carrying on research work on the various operations, and the publication of reliable data from time to time will stimulate the flow of capital into such concerns. This is a necessary step to make India self-contained in the matter of sugar.

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Oral Evidence.

A.549. *The Chairman :* Rao Sahib Venkatraman, you are the Sugarcane Expert to the Government of India?—Yes.

A.550. You put in a very interesting and instructive answer to the Questionnaire issued by the Commission. Would you rather make a statement of a general character at this stage or shall I proceed to question and answer at once?—I have no statement to make.

A.551. The Commission has of course in mind the very interesting exhibition which you arranged at the sugarcane station the other day?—Thank you.

A.552. And we are also grateful to you for all your arrangements. Would you give the Commission quite shortly the story of your professional training?—I am a Botany graduate of the Presidency College at Madras, having been a prizeman and placed in the first class. After that I had about 18 months' training as a post-graduate scholar in the same college; I was drafted into the Agricultural Department under Dr. Barber who was then the Government Botanist. I entered the department in the middle of 1907 and I had experience of teaching for one year. From 1908 to 1912 I was doing research work on various crops as cotton, *gogu* and also certain garden plants like *mirabilis* and other plants under Dr. Barber. In 1912 when the Government of India were starting the Imperial Sugarcane Breeding Station, Dr. Barber selected me to work under him and with him. I have been associated with Dr. Barber from the very commencement of his experiments on sugarcane breeding. I might perhaps mention that experiments were started in sugarcane breeding a year earlier than the creation of the post of Government Sugarcane Expert itself; because even as Government Botanist, Dr. Barber devoted attention to this work. It was certain preliminary results, obtained, even before the Sugarcane Station materialised, that induced the then Board of Agriculture to definitely recommend the starting of a Sugarcane Station. From 1912 till 1918 I have been working under and with Dr. Barber in connection with cane breeding. From 1918 onwards I have been in independent charge of the station. That brings it up to date.

A.553. To proceed at once to the central point of your proposals, I understand from your memorandum that you look with favour upon the setting up, in every major sugarcane tract, of stations linked with this Coimbatore Station, I suppose under the general direction of yourself, each station applying itself to the immediate problems of its own district?—Quite so. Only, the sub-stations which I have in mind are intended to grow the seedlings produced at this place and carry the work a step further. If I may explain, at present, sugarcanes do not flower in Northern India and therefore the seedlings have to be bred at Coimbatore. From here we send only setts or cuttings and this station being far removed from the main sugar tracts of this country, the selection made here has to be of a preliminary character; we dare not reject too many, for fear of losing some which ultimately may prove of use in the Provinces. The sub-stations, which I am contemplating, would grow these seedlings, look after them and carry the work of Coimbatore a step further. I expect, these sub-stations would shorten the work of this station by about four to five years in the attainment of results in the Provinces.

A.554. I seem to see also in your note of evidence some indication that you are not perfectly happy in your own mind as to how this proposal, which you have been enlarging upon, would be received in the Provinces within whose boundaries these stations will be situated?—I do not expect any difficulties so long as the Provinces are not asked to provide the funds.

A.555. You think that, if you are allowed to exercise your tact, and provide the funds, you will overcome all resistance?—I should think so.

A.556. I want this from you in particular; in your view is the fact that this is one of the few districts in India, where sugarcane will flower, a reason for breeding that crop in a different fashion from the standard methods, according to which, you would suggest dealing with other crops?—Yes, it is so.

A.557. So that, if I have made my question clear, you would not suggest central research or plant breeding stations reproducing themselves in every typical district throughout India, as organisations financed by and responsible to the Central Government. You would not suggest that as to crops other than sugarcane?—Not on the breeding side, no.

A.558. On the research side you would?—I should suggest Central Government Stations.

A.559. Central Government Stations?—Central Government Stations with regard to some of the major crops, to go into the fundamentals of the problems involved in connection with the improvement of each crop.

A.560. You are impressed with the success of the principle of organising research crop by crop?—Yes.

A.561. What do you think of the work of the Indian Central Cotton Committee in that respect?—I am not much acquainted with the work of the Committee; I hear it is doing very good work, but I have no direct touch with it.

A.562. I should say from certain internal evidence in your note that you have applied yourself in some detail to the system of organisation as between the Federal Department and the State Departments in the United States of America, am I right?—Yes.

A.563. Do you like the plan as it is working in America?—Yes, that is the idea.

A.564. That plan involves the spending of Central Government funds partly in Central Government Institutions and in the Provinces or States as in America, and even in institutions owned and conducted by the Provincial Services?—Yes.

A.565. Experience has shown that co-ordination in America is essential and so inter-state jealousies and the natural jealousy of the Federal Department towards the States or of the States towards the Federal Department has been overcome in the interest of agriculture as a whole?—Yes.

A.566. You would not suggest a system such as that in every detail for India, would you?—Not in every detail but in the broad outline.

A.567. You would?—Yes.

A.568. This is the point we are concerned with. Would you suggest the spending of Central funds in provincial research institutes?—I do not think there is any harm in it.

A.569. Do you know that in America when the Central Government so spend money, they claim and exercise the right of inspection?—Yes.

A.570. And you do not mind that I should like to have that privilege for the Central Department, but I do not know how the Provinces would receive it?—But so long as a certain amount of money is provided by the Central Government I expect no difficulty.

A.571. You are impressed with the importance of co-ordinating research work on crops throughout India?—Yes.

A.572. And you regard these problems as All-India problems and not as mere provincial problems?—Yes.

A.573. Have you any idea how funds might be made available for the Central Government without which co-ordination with the Central Government would not be attractive to the Provinces?—I have not thought about that.

A.574. Without taking you through the details of your note, or the work that you are carrying out, the Commission would like to have on the notes your own views as to the reasonable probabilities of improvement in sugar yields in India in the measurable future?—For a long time it was considered by sugar authorities, that the Province of Bihar, where are centralised almost all the important Indian sugar factories, was not likely to be able to grow a decent variety of cane. But the breeding work that has been done at Coimbatore has shown that, even in that Province, we could grow crops perhaps as good as Java. That being the case, I am indeed very optimistic about the future position of sugar, provided Government and the legislatures guarantee the necessary facilities.

A.575. By that you mean the funds for carrying out work?—Funds for carrying out research and also, if necessary, any protection to Indian sugar. In this connection I would like to say that some of the other countries in the world have had a start over India of about 60 or 70 years so far as sugar production is concerned. It will take sometime before we are able to get our factories up to anything like the standard of other countries. As an infant industry it is just possible it may need a certain amount of special protection from Government.

A.576. What proportion of the refined sugar consumed in India is imported? Can you say approximately?—I know the value of the imported sugar, but I cannot give the exact proportion.*

A.577. Are you sure that a very important proportion of the refined sugar consumed in India is imported?—It is imported; in fact the money value of the imports in sugar comes almost next to clothing.

A.578. So that an import duty on sugar would have the effect of raising the cost of refined sugar to the consumer; that is your intention, is it not?—Yes.

A.579. Is it your idea, that a demand would spring from that cause, which would lead to more Indian sugar being refined, or are you thinking of a bettering of the *gur* market?—I do not very much like anything which would lead to an expansion of the refining of the indigenous *gur* because it leads to considerable waste; I should like to see development in the direction of more factories producing sugar direct from cane.

A.580. In making your recommendation for a protective duty, you have yourself fully considered the rather difficult economic problem as to whether any duty of that sort would assist the grower of sugarcane in this country, since the cane which he grows is in the main converted, not into sugar, but consumed as *gur*?—Yes.

A.581. Do you think it is a complicated problem?—Yes; it is a complicated problem.

A.582. Have you fathomed it fully yourself?—No.

A.583. On my original question, you do look forward with confidence to a very considerable increase in the yield of sugar per acre?—Yes, I would quote the instance of Java which has been able to treble its yield per acre within 60 years. I do not see any reason why in India we should not be able to do it; our station has shown that it could be done.

A.584. Do you think Indian sugar production will require protection or subsidy or some such crutch for all time, or do you think there are conditions which at this moment favour foreign competition?—This protection will certainly be needed only for a short time, because I see that in India we have greater facilities, probably, greater than in certain other countries of the world, so far as the cost of production of a ton of cane is concerned.

A.585. Have you studied the conditions in Java?—I have not been there.

A.586. But you have read literature on the subject?—Yes.

A.587. Do you think that natural conditions there, apart from the act of man, are very much more favourable to the growth and better yield of cane than are conditions in tropical India?—It is rather a controversial question, but my own personal opinion is that our conditions are such that we should be able to produce in India sugarcane cheaper than Java.

A.588. So that, all you are asking is some assistance for a limited time so that you may have the opportunity of establishing improved conditions?—Yes.

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*About 87 per cent of the refined sugar consumed in India is imported from abroad.

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A.589. How much do you hope for from the improvement in extracting and manufacturing processes?—If the modern sugar factories were to be in operation in all places where at present *gur* is made (by *gur* I mean the indigenous crude product) on a rough calculation we shall have 30 per cent increase in extraction of the juice from the cane. There are, however, difficulties against the starting of modern factories everywhere.

A.590. Extraction by better machinery?—By factory machinery in place of the machinery used by the cultivator.

A.591. Would that give an increase of 30 per cent in the yield of sugar?—We are losing 30 per cent at present.

A.592. *Sir Henry Lawrence:* Sugar or juice?—30 per cent of juice.

A.593. *The Chairman:* Is that the same thing as 30 per cent of sugar?—No, because in the method of manufacture we are again losing perhaps another 15 per cent; so that we are losing at least 40 per cent. because of the crude methods of manufacture adopted by the cultivator.

A.594. You are doing your best to do your share in the way of improving varieties of cane?—Yes.

A.595. Do you think that other people are doing their share in the way of improving the processes?—Almost all the Provincial Departments are now engaged in effecting improvements upon the manufacture of the crude product, that is *gur;* but I do not think there is much activity towards the establishment of modern factories.

A.596. How do you account for that lack of activity?—For one thing a factory means a lot of investment of capital; that is why I advocate, towards the very end of my note, the establishment of a Government factory which would be able to publish reliable data. I believe that is likely to encourage the flow of capital into sugar concerns. At present Indian capital is rather shy of going into sugar concerns.

A.597. You do not think that anything in the nature of a duty would remove the stimulus to some extent which tends to promote improvement in processes?—In fact, I should be very careful in deciding what duty to put on and for what period, because if the duty be too prolonged, our factories will continue to be inefficient. Within recent years I have reliable information to show that the factories have greatly improved from 6 per cent extraction to almost 9 per cent.

A.598. In saying that of course you are assuming that your notion is right that a protective duty will in fact afford certain help?—Yes.

A.599. Although in conversation just now you agreed with me that that was a very difficult matter to decide?—It is a difficult matter.

A.600. Can you tell the Commission what proportion of the total area under sugarcane is under Coimbatore canes to-day?—It is difficult to give anything like accurate figures, but I can quite easily give the money value, because I have gathered that information from the district officers. The acreage I would put roughly at at least 12,000 acres; that is very rough.

A.601. Twelve thousand acres under Coimbatore canes?—Yes; that is the sure minimum figure, a figure of which I am quite sure; it may be more; it is a very conservative estimate.

A.602. What is the total acreage under cane in India?—In the whole of India it is 2¾ millions of acres. In this connection I have to mention that it is hardly three or four years since the Coimbatore canes got into cultivation, and as in all these cases the increase hereafter will be very rapid, the proportion next year may be five times this year, the year after it may be five times that again, and so on.

A.603. That is all cane bred here?—Yes.

A.604. There are certain areas for which you have not yet bred suitable canes, are there?—Yes.

A.605. You hope in the future to meet that demand?—Yes.

A.606. You are, officially, in the position of being a guest in the Presidency of Madras, are you not?—Yes; a sort of guest.

A.607. Do you suggest that you are paying something for your board?—Yes, I have just started paying for my board, because the Government of India have given me 38 acres to start work on the type of canes suitable to the Madras Presidency. I have always been in an awkward position, because my visitors are all from Madras Presidency. These visitors come to me and ask whether I have bred any cane suitable to their areas, and when I say all the cane is for the Punjab and Northern India, they say "you are a useless fellow." Hereafter, I am glad to say I will be able to show them cane suitable for Madras and Bombay.

A.608. You are now mending your ways and you are going to try?—I am trying.

A.609. I understand that Madras is also moving, and that they propose to set up their own cane breeding station?—Not a cane breeding station, but a cane research station.

A.610. Not a cane breeding station; they will depend upon you for that?—They will.

A.611. You think so?—They have to, more or less. With regard to sugarcane I am in rather a fortunate position, and that is there are so many cane localities in Northern India where sugarcane will not flower, and there are other places like Bombay and North Madras where it will, but do not produce fertile seeds; and I am not sorry for that.

A.612. But after all, you are not against other Presidencies setting up their breeding stations?—I do not mind.

A.613. I am only trying to get at the facts?—I do not think they will.

A.614. Is it agreed between you that they will depend upon you for breeding?—I think they will.

A.615. There is nothing fixed in writing?—No. In fact there is, I think, already an informal understanding. The Deputy Director has already sent up proposals to the head of his department in Madras in connection with the sugarcane research station. We have an informal understanding and we have agreed beween us that I should do the breeding and he should do the rest.

A.616. How came it that you tackled the requirements of Northern India before you tackled the requirements of Southern India?—Because the bulk of the area is in Northern India. The total acreage in India is roughly 2¾ million acres, of which half a million is in the Punjab, half a million in Bihar and Bengal, and 1¼ million in the United Provinces. Therefore I am trying to produce cane for a tract that is growing 2¼ million acres out of a total of 2¾ million acres; there I am perfectly justified. In the beginning, if you will permit me to say it, we wanted to make an impression as soon as possible on the Indian sugar problem. My station was in the first instance sanctioned for five years; if I did not show any result I would have had to go. Then, it was sanctioned for another five years. Therefore, we were anxious to show the maximum result within the shorest time, and we did show a definite result within eight years of the founding of the station.

A.617. Are you hopeful of making any substantial contribution to the sugarcane problems of Southern India?—Situated as I am at present, I do not propose to tackle any of the other problems pertaining to Southern India; but if I am wanted I could do it.

A.618. Provided you are given the staff and the money?—Yes.

A.619. Have you adequate staff to deal with that at the present moment?—No.

A.620. *The Raja of Parlakimedi:* Has a geographical survey been made of the sugarcane producing areas in India?—In the Statistical Atlas there are published figures showing the acreage of cane in every Province and in every district throughout India.

A.621. Roughly, what is the area?—2¾ millions in the whole of India.

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A.622. What is the area in this Presidency?—It is about one-tenth of a million.

A.623. What is the area at present under cane, both of improved varieties and indigenous varieties in this Presidency?—I have not been doing any work for Madras until now.

A.624. The figures have not been supplied to you. Are they available?—The figures are available, but I did not interest myself in those figures because I was not doing any work for Madras.

A.625. Are you in touch with other parts of the world where sugarcane is grown or sugarcane research is conducted?—I am in touch through correspondence the work done at Coimbatore has now attracted world-wide attention; other people who are working in the same line are corresponding with me; that is the only touch. I have never been outside India.

A.626. But you are taking advantage of the research work done in other parts of the world?—Of course; I am feverishly trying to get all the information I can from all over the world.

A.627. When you are creating these different varieties of canes, what are the main factors to which you pay attention?—At present, I am concentrating most attention on what may be called the tonnage of cane per acre. Other things being equal, the tonnage of cane per acre, that is the quantity or weight of cane cut per acre, is the main thing.

A.628. What about the sucrose in it?—I try to make improvements on sucrose also, but I think the best way of producing early results is to work on a tonnage basis. Of course, I see that the quality I produce is not worse than the quality we already have.

A.629. So that you have not succeeded in improving the proportion of sugar from the cane?—No; I mean the total quantity of sugar produced per acre from some of my canes will be two and half times the quantity raised from local canes; I have the actual figures.

A.630. What about the proportion of refuse, when compared with indigenous canes?—As far as the canes which are now spreading in Northern India are concerned, in some cases the refuse is more, and in some the refuse is less. In fact, I have had complaints with regard to certain of my canes, that they were too good in that they did not give enough fuel. My reply was "I am trying to breed cane for sugar and not for fuel."

A.631. Have you successfully tackled the well-known diseases, such as stemborer, redrot and so on?—I have nothing to do with diseases, though I have tried to get a knowledge of them; I am not directly working on diseases.

A.632. Do you not think it is an important thing?—I am working more on the lines of producing varieties resistant to disease.

A.633. But it is necessary to know the life history of the diseases?—I do not know the life history of the diseases in detail, but I know the main factors of certain of the important diseases.

A.634. Then, in a way, you do tackle the difficulty?—I do, from the breeding point of view.

A.635. So far, is anybody in Southern India taking advantage of this station?—I would not exactly say that they have taken advantage of it. I have not been doing much work for Madras yet, but even now one of the canes produced originally for Bihar has done well at Anakapalle, and I read in one of the monthly digests published by the Agricultural Department, Madras, that Co. 213, which is popular in Bihar, has been found to be useful as a drought-resisting cane at Anakapalle.

A.636. But you do not entirely close your doors to Madras demands?—No. I am like a merchant who has got wares for any kind of customer. It is for the customer to choose whatever he wants; I am trying to increase the range of my wares. I have got the cane, which needs large quantities of irrigation, the planter's cane, the rich man's cane and the cultivator's cane; that is my idea.

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A.637. *Sir James MacKenna:* Do you think there is any scope for the medium Coimbatore canes, such as Co. 213, in the Bombay Presidency?—I think it is distinctly worth a trial.

A.638. Have they not tried them yet?—Not yet.

A.639. Why not?—The farm at Manjri does not easily favour a cane which is thinner than the Pundia cane to which they are accustomed; but I think it is distinctly worth trying.

A.640. Because Pundia requires very heavy manuring and heavy cultivation, and therefore it is not a poor man's cane?—Co. 213 is not a poor man's cane.

A.641. It is a luxury cane?—It is the ordinary cultivator's cane; in fact, it will probably require much less water than Pundia itself. In this connection, I might mention that Java which once plumped more on the thick canes is now turning towards medium canes, and if the ryot wants a sure crop, my canes will help him better.

A.642. Have the Bombay Government approached you to provide them with improved varieties of canes?—If I may say so, that is one of the Provinces, I am sorry to say, which has not been very cordial towards Coimbatore.

A.643. Barring a few exceptions, are all the Provinces assisting you in conducting tests of your canes adequately?—I would not say all the Provinces. Most of them are.

A.644. Have you had any refusals from any other Province or have they shown lack of interest?—It is not exactly refusal; want of cordiality is enough. For example, these canes have to be tested, and unless the local officer is very cordial, I should think twice before giving him a cane of whose merits I am not certain. If it does not turn out satisfactory, he will at once say, " The Coimbatore man has given this cane and see what has happened to it "; therefore, they must be absolutely cordial.

A.645. So that the lack of cordiality is an incentive to produce a higher standard. Are you co-operating in your main research work with the Scientific Section at Pusa?—Yes.

A.646. Both Mycological and Agricultural?—Yes.

A.647. What about your successor? Is that not an important matter?—Yes.

A.648. It is a very important matter; what arrangements are being made for a successor capable of carrying on your work at the same high standard?—There is a second officer, who has already joined; he joined six months back, and if I live up to 55, he will be working with me for 12 years; that is quite ample, I think.

A.649. Are you going to send him to Cambridge, or are you going to keep him in your own hands?—That again, is a point; sugarcane breeding differs in essential respects from other crops; there is no question of Mendelian ratios to speak of. We are just beginning to have indications of Mendelian ratios; only six months back we got something like an indication. I do not think a visit to Cambridge would be of much use.

A.650. That is your personal view?—That is my personal view.

A.651. So that, you think, with 12 years' training this man will be able to carry on the Barber and Venkatraman traditions?—Yes.

A.652. *Sir Henry Lawrence:* What has been the effect of recent changes of price on the area cultivated for *gur*, either in this Presidency or in other parts of India?—I have not studied that question much; I should not like to hazard any figures except this general statement that the area sown varies according to the market price of *gur*.

A.653. You have shown us some very interesting charts, giving the importation of Java refined sugar, and I understood that you wished to have measures taken which would reduce that importation?—Yes, and stop it ultimately.

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A.654. On the ground, amongst other things, that it caused a large efflux of money from India?—Yes.

A.655. Rs 15 crores?—Yes, 15 crores is the average for ten years.

A.656. Since you prepared that chart, which gave an importation of 450,000, the importation has in fact gone up to 700,000 tons?—It has.

A.657. Is there any office from which we can obtain information to show what is the effect of this importation of refined sugar on the cultivation of cane by the ryot?—The only office I can think of, which might give this information, is the Sugar Bureau at Pusa.

A.658. The price of *gur* has been fluctuating?—It has.

A.659. In this Presidency?—Yes.

A.660. Does it fluctuate in any relation to the price of imported refined sugar?—It does.

A.661. Can you establish a relationship?—There is a general relationship between the price of *gur* and the price of sugar in the market.

A.662. So that, large importations of Java sugar are likely, in your opinion, to reduce the price of *gur*, and thereby reduce the incentive to the cultivator to grow sugarcane?—Yes.

A.663. You have no very definite opinion on the point?—No.

A.664. You have not worked it out?—No.

A.665. Nevertheless, you are now proposing a protective duty against refined sugar?—Yes.

A.666. On what do you base that proposal, if it is not for the protection of the cane cultivator?—It is for the protection of the Indian sugar industry, which includes the cane cultivator as well as the factories that may come into being.

A.667. But the factory industry in India, you will agree, is very small as compared with the interests of the cane cultivator?—I should like to see the factory industry grow. Unless we expand the factory industry, we will continue to lose in the manufacture, and all the good work done in other directions will be lost. In these days, it is impossible to go on producing sugar under the old methods, because they are wasteful methods of manufacture; we have to be up to date, we have to be abreast of the world.

A.668. Do you find, then, that in this matter of waste, you are against factories which are making refined sugar from *gur*?—Yes.

A.669. Is that the practice in any factories?—No, not in many factories in Northern India.

A.670. Do they not make their refined sugar direct from the cane?—Yes, in Bihar most of the factories make sugar direct from the cane; that is the economical way of producing the sugar.

A.671. What is this waste that you complain of?—It is like this; if you had a ton of cane and produced sugar direct from it, you would get much more than if you had the ton of cane converted first into *gur* and from the *gur* into sugar.

A.672. Quite true; but where do you find this refining from *gur*?—Even here, in Madras, there are one or two factories which are doing the refining from *gur* on a small scale; there is one at Samalkot, there is one at Tinnevelly and there is one at Unao.

A.673. Is that a large proportion of the total amount of refined sugar made in India, that is, of 100,000 tons? How much of that is made from *gur* and how much from the cane?—I do not know the accurate figures, but it is not a very large proportion.

A.674. Talking of this Coimbatore cane in its applicability to Bombay canals, you say that the Manjri farm has not been very cordial towards your cane; does that mean that they have reported that your cane has not done any good?—Not exactly that.

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A.675. That would be lack of cordiality; would it not?—I would not call it that. If they really found it bad and threw it away, I would have no objection. I am producing every year 2 lakhs of new varieties, and the bulk of them will be thrown out somewhere; I do not mind.

A.676. You complain that they have not tried your canes?—I might probably mention the actual case. When I go up to Manjri farm sometimes I am not allowed to go through their cane crops except with the officer and in one instance I had to wait two days sending out telegrams, doing nothing; I was at the Manjri farm but could not see the canes.

A.677. What is the year?—I do not remember the exact year.

A.678. Is it five years ago, ten years ago?—Probably about six years ago; it is probably better not to give the exact date.

A.679. That discourages you from going on?—Yes.

A.680. *Sir Ganga Ram:* In your experiments do you keep a record of the water that you use? What quantity of water do you use?—We do not carry out any definite experiments on the water requirements of the sugarcane. But on this Coimbatore station I am using something like 100 or 120 acre inches of water.

A.681. How much water do you require for 100 acres?—Our figures are on acre inches as we call it. In an irrigation, if the cultivator allows an inch of water to stand in the field, it is called an acre inch. It is based on something like the rainfall.

A.682. You use how much water, 100 to 120 acre inches?—Yes.

A.683. Do you know that in Bombay your cane is not making any headway?—Not yet.

A.684. Why?—The Bombay people are quite accustomed to the thick type of cane and the canes I have bred so far are all either thin or intermediate. I have yet no thick canes bred from the Coimbatore farm to give them.

A.685. Why have not the United Provinces, who are chiefly sugarcane growers, taken them up?—They have; the Coimbatore canes are spreading rapidly in that Province.

A.686. They are spreading?—Yes, and with the advance of time they will cover every acre there almost.

A.687. You are not charged for water here?—No, because it belongs to Government.

A.688. It is free?—We pump most of our water from the wells. I have to pay for the pumping; I have an oil engine.

A.689. The ryot also does that. In certain places where they have facilities for working from the canal, water-rate is charged. How much are they charged? That is what I want to know?—That I cannot say. In my farm I do not use much canal water.

A.690. Do you grow any coarse paddy which harvests in two months?—Paddy is not my line.

A.691. You do not grow any sugarcane which matures in two months?—I have not heard of a cane like that.

A.692. What do you advise the people to grow after you take the sugarcane off the ground?—I would not advise them because I do not know the local conditions.

A.693. What is the practice?—That differs in various places.

A.694. Do they put sugarcane after sugarcane?—No.

A.695. They do not?—No.

A.696. They put something else?—Yes. They put something else generally.

A.697. They do not put cotton? The best thing is to put cotton?—No; they do not.

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A.698. Can you tell me with regard to a crop of sugarcane, what chemical properties does it take away from the soil?—I have not worked in that line.

A.699. *Sir Thomas Middleton:* You gave us the opportunity of seeing your work. You pay very great attention to the root development of your cane? —Yes.

A.700. It is from the root development that you judge whether cane is suitable for light soil or heavy soil?—Yes.

A.701. You have already indicated that you are growing an intermediate or thin type of cane. What is your ideal diameter in your intermediate cane? What size are you working on?—Somewhere between ¾ inch and 1 inch.

A.702. For your thin cane, what standard do you take?—Less than ¾ inch.

A.703. What height do you work up to? What is your ideal height for these different types?—That again is rather a complicated problem. It all depends upon the locality. If I want to introduce a cane to a locality where there are high winds I would not try to produce a tall cane. I would rather make up the tonnage by a greater number of canes to the field; it all depends upon the locality.

A.704. I expected that type of answer. But I was going to ask you what are the limits between which you work? For these districts where the winds are high you would select canes how many feet in height?—I should like to put it as low as 12 feet, but at present probably it is practicable to put it at about 15 feet high.

A.705. For districts where the winds are high?—Yes, 15 feet.

A.706. And how many canes from the stool do you consider sufficient?—That again depends upon the locality and upon the amount of seed I can get to the acre. I would on an average put it at about 8 to 12 canes to the stool.

A.707. What I was getting at is this; certain of your canes are free tillering varieties and certain are not?—I have both types.

A.708. For those localities in which you have high winds you want a free tillering variety?—Yes.

A.709. And a free tillering variety you describe as 8 to 12 to the stool?—I would rather put it at 12 to 18 for very free tillering varieties.

A.710. Let us now take the other extreme, the locality in which you want a tall cane. What size do you aim at?—It may be anything, in fact over 20 feet.

A.711. What is the maximum height of the Java canes? Can you tell us? —By the cane I must here mention I mean to the tip of the leaf.

A.712. Yes; what is the maximum height you know of the Java canes?—There are some Java canes which are only about 12 feet. There are other Java canes from 12 to 15 feet. Some of them are even 20 feet.

A.713. For certain districts you are growing much taller canes than the Java canes?—Yes.

A.714. When you grow the taller canes what amount of tillering do you want?—If it is a very tall cane, I would not go beyond four or five tillers.

A.715. Even in the places for which you are now working you have quite a number of different qualities to satisfy?—Yes.

A.716. Although you have as yet done very little for Bombay?—Yes.

A.717. Now coming to the next point, when you are making a cross how many fertile seeds do you aim at getting from one cross?—A sugarcane has got a very large number of flowers and in one pollination I can pollinate all.

A.718. But you do not do that, do you?—I do it on four different days.

A.719. Then you get from each process a very large number of seeds?—A very large number.

A.720. Do you actually grow all the seeds?—Up to about six weeks, all of them.

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A.721. How many crosses do you make in a season?—It all depends upon the nature of the season. In a favourable season I make about 30 or 40 combinations. The number of crosses will be more.

A.722. How many thousands of seedlings?—I generally raise every year about 2 lakhs of new seedlings.

A.723. And is it the case that no one seedling is identical with its neighbour? —I have got accurate data with regard to a particular sowing where from a single flower, that is without any foreign pollination, we grew 2,700 seedlings and no two of them were alike. We described them with 30 or 40 botanical characters and none was like the parent.

A.724. You have got, we understand, a monopoly of the seedling raising business, but your monopoly provides a wide range of varieties. You ought to be able to provide every customer with suitable wares?—We are trying to do so. I am quite optimistic about it.

A.725. What you are anxious to secure is assistance in testing out these seedlings?—That is all.

A.726. Not in their production?—No.

A.727. In the work in which you are engaged are not many thick seedlings thrown out by chance, although you make crosses for thin seedlings?—Generally not.

A.728. Not many?—In fact none at all. I have such experience now for about 12 years and I have found none at all. If I want thick cane I have to choose a different class of parents.

A.729. It is surprising that with such a very large number of seedlings some of them should not have developed the thick character?—It is because none of the parents used were thick.

A.730. Your present limitations are really limitations of time? That is a most serious limitation?—Yes, chiefly time. Now we have got a fairly sufficient amount of land.

A.731. And the methods you are familiar with, at any time you could work upon a different series of types?—Yes.

A.732. At any time you could produce canes of almost any description?—That is what I think. I am very optimistic about it.

A.733. It is all a question of time?—Yes.

A.734. You informed us that you were the only one trained officer. Would it not be advisable to have two. Something like a life-insurance?

A.735. Do you generally provide for two or three?—I have got at least four people who could do breeding all right.

A.736. That is my point. I understood that there was only one assistant who was doing breeding work?—No. The whole staff can do it.

A.737. *Dr. Hyder:* I want to know whether you have made any original contributions to the study of canes or cane breeding or you are simply carrying on the work in which you were initiated by Dr. Barber?—I have made material contributions on the breeding side of sugarcane and this has been duly recognised by the leading sugarcane journals of the world. In fact I could show you one or two cases where they have editorially reviewed my work with very great favour. Carrying on the work at the station is not like the carrying of a substance from one place to another. It is something like bringing up a growing child, problems develop as growth progresses. The child develops indigestion and kicks about and various devices have to be contrived by the person in whose charge it is. If I may say so, from the very beginning my contributions towards the breeding of sugarcanes have been material and my master Dr. Barber has himself handsomely acknowledged my work in some of his first publications.

A.738. Your works have appeared in print?—A number of them.

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A.739. Have your canes been tried outside India?—Yes. There is one instance, which I quote, of a report from Cuba. My canes are now going almost everywhere. I am told that even Java has got them now.

A.740. Regarding the question of import duty, could you tell me what the real cost of production per maund is apart from the cost which is given in statements submitted to the legislature or to a committee?—I happen to know that in Bihar the cost of production per maund of cane, this is based strictly on information given to me, was in one instance hardly three annas, that is, the cost of production on the plantation. It compares very favourably with the cost of production in other countries of the world. It may be observed here, that, in the main cane tracts of India, the climatic conditions are such that we can grow cane very cheaply. In the United Provinces there is sometimes no need for irrigation. Bihar has such a rich, deep soil that we are able to get a very good crop indeed. It is my considered opinion that in India we should be able to produce cane at a much cheaper rate per maund than in the other sugar countries of the world.

A.741. So much for the people. What about the manufacturers and business men? They might perhaps have an import duty. You are of that opinion?—Yes.

A.742. *Sir Ganga Ram:* You use 120 inches of water. If your water were reduced would your yield be comparatively reduced?—I will just explain. This 120 inches of water was the average for the whole farm. But I have got varieties which could grow in 70, 50 and 40 inches. In fact I have got a cane in the Punjab which grows without any irrigation. It is a cane which has a deep rooting system and it produces sugar without irrigation.

(The witness withdrew).

The Commission then adjourned till 10 A.M. on Friday, the 19th November, 1926, at Madras. For evidence taken at Madras from 19th to 25th November, 1926, except that of Lt-Col. R. McCarrison (Imperial) which follows, see Volume III.

Thursday, November 25th, 1926

MADRAS.

PRESENT:

The MARQUESS OF LINLITHGOW, D.L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.

Sir THOMAS MIDDLETON, K.B.E., C.B.

Rai Bahadur Sir GANGA RAM, Kt., C.I.E., M.V.O.

Sir JAMES MACKENNA, Kt., C.I.E., I.C.S.

Mr. H. CALVERT, C.I.E., I.C.S.

Raja Sri KRISHNA CHANDRA GAJAPATI NARAYANA DEO of Parlakimedi.

Professor N. GANGULEE.

Dr. L. K. HYDER.

Mr. B. S. KAMAT.

Dewan Bahadur T. RAGHAVAYYA PANTULU GARU.
Rao Bahadur B. MUNISWAMI NAYUDU GARU.
} (*Co-opted Members.*)

Mr. J. A. MADAN, I.C.S.
Mr. F. W. H. SMITH.
} (*Joint Secretaries.*)

Lieut.-Colonel R. McCARRISON, C.I.E., M.D., D.Sc., LL.D., F.R.C.P., I.M.S. (in charge of the Deficiency Diseases Inquiry, Indian Research Fund Association, Pasteur Institute, Coonoor, S. India).

Memorandum on Malnutrition as a cause of physical inefficiency and ill-health among the masses in India.

The object of this memorandum is to indicate (*a*) the great importance of malnutrition as a cause of physical inefficiency and ill-health among the masses in India; (*b*) the intimate connection which exists between problems of nutrition and those of agriculture; and (*c*) the necessity for the closer co-ordination of nutritional, medical, veterinary and agricultural research in this country.

1. Of all the disabilities from which the masses in India suffer malnutrition is, perhaps, the chief. The more spectacular, endemic and epidemic diseases, such as cholera, malaria, dysentery, tuberculosis and leprosy, kill their thousands yearly; but malnutrition maims its millions, and is the means whereby the soil of the human body is made ready for the rank growth of the pathogenic agents of many of those diseases which afflict the Indian people. It has, for example, been shown by researches carried out under the auspices of the Indian Research Fund Association, that dysentery—a common scourge of India—can be produced under experimental conditions in animals, closely related to man, merely by feeding them on food deficient in certain substances (vitamins) upon which

normal metabolism is dependent. It was found that while well-fed animals might harbour the *entamoeba histolytica*, which is the cause of dysentery, they did not develop this malady although living in the same room and subject to the same risks of infection as ill-fed animals which, being carriers of this organism at the time the experiment commenced, developed dysentery in consequence of the lack of resistance to it brought about by the defective food. Similarly, it has been shown that hog-cholera and other infections can be caused to overrun the animal organism by the same means. These observations have now been confirmed and extended in other countries; and quite recently it has been found that the susceptibility to tuberculosis, typhoid fever and pneumonia—all of which are very prevalent in India—is greatly enhanced by the use of food of low biological value which contains an inadequate supply of vitamin A. Investigations of this kind have made it possible to enunciate the rule that many pathogenic agents of disease are capable of exercising their harmful effects only when the human or animal body is debilitated by various means of which imperfect nutrition is the chief. It follows, therefore, that a primary essential in the prevention of such diseases is the adequate nourishment of the human and animal organism. A number of other diseases of a metabolic nature are likewise the result of improper food. Of these it is only necessary to mention scurvy, rickets, beriberi, certain eye diseases and stone in the bladder, all of which exact an enormous toll in this country.

The effect of imperfect food in causing a degree of physical inefficiency, which may not be associated with any gross evidence of disease, is exemplified in India as in few other countries in the world. Few who have travelled far in India can have failed to observe the remarkable difference in physical efficiency of different Indian races; and although there are a number of factors, climatic and other, which play their part in determining these differences, yet it has been shown by researches carried out in this laboratory, and by Colonel McCay in Calcutta, that nutrition is the chief among them. The differences in physical efficiency of different races in India have been definitely correlated with differences in the biological value of foods which necessity, habit, or religious prejudice has forced them to use.

Malnutrition is thus the most far-reaching of the causes of disease in India. It is one of the greatest—if not *the* greatest—problems with which the investigator of disease is faced. It is, too, the chief among the problems facing those engaged in agricultural research. The ultimate aim of both is the same: the adequate nutrition of the people. So far, then, from agricultural and nutritional research being carried out in isolated compartments, there should be the closest co-operation between them, to the mutual advantage of each and to the widening of scientific vision.

2. It is not alone in regard to the human subject that malnutrition exerts such harmful effects. Man's domestic animals suffer no less than he himself. It suffices in this connection to refer to the effect on cattle of pasturage which is deficient in certain mineral ingredients. As an example of this kind the now well-known effect of deficiency of phosphorus in the soil, and, therefore, in the vegetation, on the health of cattle and sheep may be mentioned. Such deficiencies exist in large tracts throughout India as, for instance, in the soils of Bihar. In India, unfortunately, millions of stock exist in a state of semi-starvation. As draught animals they are consequently inefficient; and as producers of milk and milk products—so essential as food for mankind—they are more inefficient still.

There is, perhaps, no more important department of agricultural and nutritional research than that which deals with animal husbandry; and here I should like to emphasise that the problems of animal husbandry are also the problems of human husbandry.

3. Human and animal inefficiency is reflected in the soil; in its imperfect cultivation; in inadequate manuring; and in crops scanty as to quantity and deficient as to quality. Too few animals are kept by the cultivator, as the scanty vegetation cannot support them; and so there is

returned to the land too little of that organic matter, in the form of farm-yard manure, on which the continued fertility of the soil is so dependent. It has been shown in regard to plants, as in regard to animals, that they cannot thrive, nor their seed attain to the fullest "reproductive quality", unless they be provided, in addition to the mineral constituents of their food, with certain organic substances known as "auximones". These substances, which are akin to vitamins, are as essential to the normal metabolism of plants as vitamins are to the normal metabolism of man and animals. They not only enable the plant to build up from the simple ingredients derived from the soil those organic complexes required as food by men and animals, but they enable it to elaborate vitamins without which these organic complexes cannot be properly utilised by the animal organism. Auximones are produced in the soil from decaying organic matter by the action of certain soil bacteria; and the best organic matter for this purpose is farm-yard manure. So it is that such disabilities of mankind as are due to faulty nutrition are sometimes traceable to the soil itself, which has become exhausted and unproductive of the best kind of food through improper attention and cultivation. Malnutrition, thus, pursues its harmful course in an ever-widening vicious circle; the cultivator is too often ill-nourished and ravaged by disease which is commonly the result of his ill-nourishment; his beasts are alike ill-nourished; while both toil wearily in a heartless effort to extract from the ill-nourished earth enough to keep them from starvation. The solution of the problem of malnutrition is thus, to a great extent, one of improvement in methods of agriculture.

4. Considerations of this kind led me, in the course of the inquiry on which I am engaged, to attempt, in a way as wide as my limited circumstances permitted, a study of the soil conditions which influence the nutritive value of the commoner food grains of India. Millions of people in this country rely from generation to generation on a single cereal as the main staple of their dietary. It seemed necessary, therefore, to be aware not only of those soil conditions which influence the yield of grains but of those which influence their nutritional quality. This attempt was made not only because it was the logical outcome of the work on which I was engaged —an inquiry into the effect of faulty food on the causation of disease in general—but also with the object of widening the scope of nutritional investigations and of linking them up with agricultural research to which they are so closely allied. The soil conditions which it was thought would be likely to influence the nutritive quality of food grains were (*a*) the chemical composition of the soil itself; (*b*) the manurial treatment to which it is subjected; and (*c*) irrigation as compared with normal rainfall. So far my investigations have not proceeded beyond the experimental study of the effect of certain manures on the nutritive value of millet and wheat. They are, unfortunately, very tedious and the output of work is limited by the limitations of a single investigator. The results already arrived at are, however, of interest. It has been found in regard to millet—a common food grain in South India—that soil on which it is repeatedly grown, but which has received no manure for many years, yields a grain the nutritive value of which is so low that it may actually be harmful to the users of it; suggesting the acquirement by the grain of toxic qualities. It has been shown, moreover, that the nutritive and vitamin values of the millet grown on soil treated with cattle or farm-yard manure are markedly superior to those of millet grown on the same soil when treated with a complete chemical manure. In regard to wheat it has been found that when it is grown on soil treated with farm-yard manure, its nutritive value is approximately 17 per cent. higher than when grown on soil treated with complete chemical manure. The deficiencies of the wheat grown under the latter conditions are due in the main to an inferior content of vitamin A, that substance which is so essential in maintaining the resistance of man and his domestic animals to infectious diseases. In this work—which I venture to think provides an example of the advantages to be derived from collaboration between investigators of nutritional and agricultural problems—I have had the active assistance of the Department of Agriculture, Government of

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Madras, and of the Agricultural Chemists on the staff of the Agricultural College, Coimbatore, without which it would have been impossible to carry it out.

5. Questions of irrigation—the means to be adopted to prevent the slow but sure deterioration of soil which is constantly being irrigated, and the consequent deterioration of the crops grown upon it—are alike of interest to students of nutrition and public health and to those engaged in agricultural research. The possible bearing of these questions on the tendency towards intense malaria when dry crops are grown under canal irrigation is one of the most important of the public health problems awaiting solution. It has been referred to in detail in Mr. Albert Howard's Presidential Address before the Indian Science Congress at Bombay early in the present year: an address which brought into prominence certain aspects of agriculture and their relation to disease which are of the utmost importance to this country.

6. Among the manifold needs of India at the present time not the least urgent are these:—

(a) The wise extension of research on nutrition—plant nutrition, animal nutrition and human nutrition—under broad-minded direction. These are not different subjects but the same subject: a continued story following a natural and ordered sequence from its beginning with the soil, through vegetable and animal life, to its final stage in the man himself. In the telling of this story India should be encouraged to play an adequate part. My experience of Indian assistants has taught me that nutritional research is of a kind which appeals to the Indian possessed of the necessary scientific education. For my own part, I would desire to see many such young Indians trained in its prosecution and engaged upon it under proper direction.

(b) A second need is the co-ordination of all the forms of research—nutritional, medical, veterinary and agricultural—which have for their aim the betterment of the health and physical efficiency of the people of India. It is essential that those who are engaged in agricultural research should be aware of its bearings on public health or *vice versa*. At the present time much effort is dissipated for want of such co-operation between research workers. The matter is, however, beset with many difficulties. I mention it merely to indicate its importance.

It is, I believe, only by the extension of research along broad lines, by its proper co-ordination, and by the employment of the best brains which India can herself provide, that this country will obtain the highest return for money expended upon research.

Lieut.-Col. R. McCarrison.

Oral Evidence.

A.743. *The Chairman:* Colonel McCarrison, you are a Member of the Indian Medical Service and you are in charge of the Deficiency Diseases Inquiry, which is under the Indian Research Fund Association, at the Pasteur Institute, Coonoor?—Yes.

A.744. Sometime ago you provided the Commission with a note giving an outline of the work on which you are engaged; since then my colleagues and I have had an opportunity of visiting your Institute at Coonoor, of seeing your work and of having the advantage of an explanation by yourself of what you are doing there; but we were anxious to get some facts connected with your work and some of your views and so we have asked you to come here to-day. I understand from what you have already told us that it is your view that the Institute over which you preside at Coonoor, the Agricultural Research Station at Coimbatore and the Animal Nutrition Section at Bangalore, from the fact of their relative contiguity, offer a great opportunity for the extension of your work in this Presidency?—That is my opinion. One point is that I am not in charge of the Pasteur Institute at Coonoor; I am a guest there; I have my laboratories there. But I feel that Madras is very fortunately situated for research work on nutrition in all its branches, human, animal and vegetable, because of the nearness of Coonoor, Coimbatore and Bangalore to each other.

A.745. I take it that it is your view that the general problems of malnutrition in man and beast bear very closely on the terms of reference of this Commission?—Yes, I think so.

A.746. I shall ask you to describe some of your work in a moment or two; what other work of this nature is being carried out in India at this moment?—As far as I am aware there is no work being carried out in India on nutrition at the present time except what I am doing.

A.747. So that, so far as nutrition in man goes, you are the only officer engaged on research on an absolutely vital problem affecting the welfare of 300 million people?—Yes.

A.748. Are you carrying on the work as a successor of someone else, or did you create this work yourself?—I created it.

A.749. Have you any successor in view?—I know of none.

A.750. If you went to-morrow, would your work be carried on?—There would be no one, so far as I am aware, who could carry on, who has devoted his life to the study of nutrition as I have done.

A.751. How many years have you been engaged in this work?—My work in connection with nutrition itself I started in 1913, just before the War; it was interrupted by three years' active service; then I came back to it again; it was interrupted again owing to financial retrenchment and it has been finally re-established 15 or 16 months ago. Every time I have gone the work has come to an end and has had to be started afresh, even to the making of my animal cages and so on. Right from bed-rock I have had to start afresh every time. Personally I think that is a great pity. I feel that this work on nutrition is of such vital importance to the people of this country that it ought to be put on a permanent basis.

A.752. What basis do you suggest?—I suggest that there ought to be established at once or as soon as possible an institute of nutrition which would deal with problems of nutrition in human beings, animals and plants, because nutrition is not a matter which refers only to the human being; nutrition refers to men, animals and plants.

A.753. Would you suggest that such an institute should be under the Government of India or under the Government of some Presidency or Province?—There is room for such an institute in every Presidency in this country. There is room for another one under the Government of India. My experience is limited to this Presidency, and as I said, this Presidency is particularly suited for the work.

A.754. I suppose your own feelings are that you are not very much concerned how continuity is attained provided it is attained?—That is so. My business is to do the work; it is the business of others to see it is continued.

A.755. You have no firm views as to whether your own particular institute, if it could be connected up with Coimbatore so far as plant nutrition goes and with Bangalore for animal nutrition, should be under the Provincial Government or the Government of India?—No, I am not concerned with that.

A.756. Have you sufficient space at Coonoor to extend?—No, I have not. I have got three laboratories there; that is all that is available there at the moment for work in connection with nutrition.

A.757. Have you the land upon which further buildings could be erected?—There is a good deal of land, I understand, connected with the Pasteur Institute at Coonoor, if it is decided to make that a centre of nutrition work, where buildings could be erected if they were necessary.

A.758. Is it your view that Coonoor is an appropriate place in which to carry on this work?—I think it is an ideal place.

A.759. Are there any buildings in the immediate neighbourhood of the building at present occupied by your animals and so forth, which might usefully be leased or bought?—There is a vacant jam factory which is next to the Pasteur Institute; the grounds of the two institutions are side by side; the buildings are eminently suited for nutritional work, but I understand it is the intention to apply them to some other purpose, with the details of which I am not familiar.

A.760. Official or non-official?—I only know this unofficially.

A.761. The use of the buildings is to be non-official?—No; official.

A.762. Now I think I may leave you to give the Commission an outline of your work; I think it must be an outline only, because plainly we are not as a body concerned with the detailed scientific aspect of the work which you are doing at Coonoor, and I hope you will bring out if possible the direction in which man and beast inhabiting these areas are suffering from malnutrition, and if possible indicate to the Commission the sort of direction in which within the economic capacity of the individuals who are suffering from malnutrition some steps to remedy the situation might be adopted?—By " malnutrition " I mean the impairment of the normal physiological processes of the body consequent on the use of a food which is deficient in quality although it may be abundant in quantity. The remarks which I have to make do not therefore deal with the problem of starvation or of semi-starvation which I recognise as being also an important cause of malnutrition; I am dealing solely with the quality of the foods in common use in this country and with their capacity thoroughly to satisfy the functions of food. The functions of food are four-fold,

(1) to repair tissue waste,
(2) to supply energy,
(3) to maintain the normal medium in which the bio-chemical processes of the body can take place, and finally,
(4) to make these processes possible.

My work has been chiefly concerned with the last of these, that is to say, with vitamins: substances the function of which may be compared to that of the spark which ignites the fuel mixture of a petrol engine liberating its energy. The spark is of no use without the fuel, nor the fuel without the spark. I would like now to show you what are the effects on animals which receive an adequate diet consisting of proteins, fats, carbo-hydrates, salts and water in proper proportions but which is lifeless owing to the want of these substances, vitamins. This chart (marked " A ")* shows that if rats be fed on a diet containing everything they require, proteins, fats, carbohydrates and salts, but without vitamins, they will not grow and after a very short time they become paralysed. These are paralysed rats which have been fed on an otherwise adequate food which contained no vitamins. The same results follow in pigeons, men, monkeys and other animals. One of the chief foods in use in India and in this Presidency especially is rice. I should like to show you that rice is a fundamentally poor diet; it is a diet which in itself will not support the human body in its fullest efficiency, although the people who are using rice may be eating it in large quantity. In this chart (marked "B") the lower curve relates to a group of animals which have been fed on an otherwise complete diet containing no vitamins. To this diet I added one gram of rice so as to provide the necessary spark, the vitamins. The next curve indicates the rate of growth under those conditions. If instead of adding one gram of rice I add one gram of wheat the difference is enormous. Rice is therefore a fundamentally poor diet. I next tried to ascertain why it is that rice is so poor; so I added vitamin A to it. The next curve indicates the rate of growth. I then added vitamin B, and the next curve shows the rate of growth. Yet I was unable to make it equal to that given by one gram of wheat, the reason being that rice contains a protein of poor biological value and is also very deficient in certain substances such as manganese which is very important for growth. Here is the chart (marked "C") of which I have shown the original photograph. If now I take a diet which is complete in every regard, proteins, fats, carbo-hydrates, salts and vitamins, and add to it a slight trace of manganese, as much manganese as there is in wheat, wheat being particularly rich in it, you will see I make good to a great extent the deficiency of rice; that is to say, I have got to add vitamins A and B and manganese before I make rice equal to wheat in nutritional value. This is exemplified in another way; here is a chart (marked "D") which represents the difference in nutritional values of certain grains in common use in India. This one is wheat; these curves represent *cholam* and *cumbu*, two grains in common use in this Presidency, this one represents paddy. The two rats at the bottom represent the difference between a wheat rat and a paddy rat. When the Commission did me the honour of visiting my laboratory, they saw there an experiment dealing with the relative values of the national diets of India tested biologically on groups of animals of the same original weight. These diets are representative of different peoples, Sikhs, Mahrattas, Pathans, Gurkhas, Kanarese, Bengalese and Madrasis. You will see on this chart (marked "E") that the diet of the wheat-eating people of the north who also take a great deal of milk, butter and *ghi*, far surpasses in value that of the rice-eating people of the south. The upper chart shows the distribution of leprosy in this country. You will notice that the greatest prevalence of leprosy is amongst the people who use the poorest food while the least prevalence of leprosy is amongst the people who use the best food.

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* Figures and Charts follow after page 116. Chart " A " has not been reproduced.

I have chosen leprosy to represent and emphasise this particular point, but it is not only with regard to leprosy that this is true; it is true with regard to other diseases. For example, the death-rate from cholera in Madras is 40 times greater than it is in the Punjab. Chief amongst the diseases which these deficiencies in diet cause are diseases of the gastro-intestinal tract. I see from the report of the Surgeon-General with the Government of Madras for last year that there were no less than 9,500,000 attendances at the hospitals and dispensaries of this Presidency. In the course of my work, I have produced in animals acute gastro-intestinal diseases like diarrhœa, dysentery and so on, and chronic gastro-intestinal diseases like dyspepsia, dilatation of the stomach and colitis. Of these 9,500,000 attendances at the hospitals and dispensaries of this Presidency, I calculate that no less than 3 millions are ill-nourished, and are suffering from diseases which are directly or indirectly due to malnutrition. In this chart (marked "F")* you will see what the effect of a perfectly good diet is on the gastro-intestinal tract of a monkey when that diet has been killed by auto-claving in a temperature of 130° C. for an hour and a half, which has had the effect of destroying the vitamins. This is the gastro-intestinal tract of a healthy monkey which was living in the jungles of Madras 3 or 4 days before I put it under experiment. The lower chart shows what the effects of the devitaminised diet are.

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* Not reproduced.

Lieut.-Col. R. McCarrison.

There is great dilatation of the stomach, the colon is converted into an inert bag, causing chronic constipation and all the evils which result therefrom. It is not only with regard to food deficiencies that this work of mine deals, but also with regard to diseases arising from poisons contained in the food grains. You will see here a picture (marked "G")* of three: a man and two boys. The man is of magnificent physique, from Hunza, where lives probably one of the finest races of mankind. He and many others were transferred in my time as Agency Surgeon at Gilgit to a new tract of land, where the wheat grown was of very poor quality and therefore they had to grow a vetch called *lathyrus sativus* with the result that they suffered from Lathyrism, which causes a kind of paralysis, and has paralysed these subjects from waist downwards. Nutritional work does not deal only with deficiencies in food. Here is another chart (marked "H"), which illustrates the difference between a Sikh diet, illustrated by the upper curve, and a diet which is in common use among the poorer Europeans, both in this country and at Home. I took two groups of animals of the same initial weight and one of them I put on a diet consisting of milk, green vegetables, butter, fruits, whole wheat bread and occasionally meat; you will see that they did very well, whereas the animals that were fed on the poorer European diet did very badly. That diet consisted of white flour (white bread), tea, sugar, margarine, jam, potted meat and boiled vegetables. The potted meat and margarine contained such preservatives which are now in common use, namely boracic acid, sulphurous acid and formal-dehyde. I wish to emphasise that the second group of animals died from two causes, gastro-intestinal diseases and lung diseases. Lung diseases are among the most common diseases in this country. You will see in this chart what you might call for the purposes of explanation the Sikh rat and the poor European rat. Not only does the poor European diet give rise to these conditions, but it also produces new growths in the stomach, which I am investigating at the moment, and which may be, although I am not prepared to say so at present, the beginnings of cancer. You can see what the appearances of the two groups are in this picture.

The next picture to which I would like to refer shows the effect of white flour, which is nowadays being so commonly used not only outside this country but also in this country. These animals were fed on the usual diet which contains everything except vitamins. One group was given 1 gramme of white flour, the other 1 gramme of whole wheat flour (*atta*) to supply the vitamins. You will see that the former did not grow, whereas the rats which were given 1 gramme of whole wheat did grow, but in the former case immediately I added the vitamin, they grew so quickly that they overlook the others. I show here one of the animals that were getting the wheat, one of the animals that were getting white flour, and a paralysed animal that was getting the basal diet only. At this point I added vitamins and you see from the chart (marked "H2") how rapid the growth was. In connection with the susceptibility of mankind, when they are so fed, to disease, I should like to emphasise in this chart that men living at this level have but a short race to run before death overtakes them, if they be infected by something like cholera or dysentery, whereas if better fed, they have a much better chance of escaping death. The next illustration (marked "I")* contains life-size pictures of stone in the bladder, which I have produced in animals by feeding them on a faulty diet. I wish to remark that this is one of the diseases in this country which is so prevalent and which causes an immense amount of distress; I have succeeded in producing it in animals, and therefore I hope to succeed in doing away with it in man if people are only able to feed themselves properly. I have already drawn your attention to the fundamental poverty of rice as a food. In addition to this poverty of the grain as it comes from the field, it is subjected to all sorts of milling and polishing processes. This chart (marked "J1") represents groups of animals fed on the same rice which was specially grown for me by the Agricultural Department of the Government of Madras; and which has been subjected to the various milling processes. The first curve shows the effect of a diet of the original paddy; it does no more than just support the animal at maintenance level. When the rice is par-boiled, it just fails to support them at maintenance level. In connection with this failure to support them at maintenance level, it fails to keep them in health; one of the chief complaints from which they suffer is eye disease. In this Presidency alone there were no less than 885,000 people attendances at the hospitals and dispensaries for eye diseases; that is to say 1 in every 50 of the whole population.

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* Not reproduced.

A.763. *Professor Gangulee:* That is due to the deficiency of vitamin A?—A great part of it is due to the deficiency of vitamin A. When you proceed to polish the rice, you greatly reduce its food value, until you get the highly polished rice which is so widely in use, and is quite incapable of supporting life; and unless it is supplemented by other articles of diet, health cannot bé maintained.

A.764. *Sir Ganga Ram:* Polished rice is rather a luxury for European countries, is it not?—Yes, it is, but I do not think European countries are as yet very much wiser with regard to food than we in the East. This chart will illustrate to you how the disease of beriberi occurs in this Presidency. Beriberi is a disease which is peculiarly the property of the Madras Presidency; it occurs on the East Coast of Madras, and practically nowhere else in India. You see in this chart (marked " J2 ") the food value of rice subjected to high polishing. No man lives by rice alone; he has to take gram or *dal* or something of the kind; in this Presidency the people usually take something like 2 to 4 ounces of *dal*.

A.765. *Dr. Hyder:* What kind of *dal?*—I am not sure, but I think it is *tur dal*. Animals fed on a diet which has the nutritive value of the highly polished rice will not develop beriberi. Beriberi is due to the insufficiency in the diet of a substance called vitamin B; it is only when the insufficiency reaches a particular point that beriberi occurs. Paradoxical as it may seem, a little vitamin B is necessary for the production of beriberi.

A.766. *The Chairman:* Otherwise the man dies of starvation before he gets beriberi?—Yes, he dies of a specific form of starvation. This is a chart (marked " L ") which illustrates the relative values of various rices in use in India; they vary tremendously. Here is another chart (marked " M ")* which introduces another phase of the subject, that is to say deficiency of certain mineral elements. Deficiency of iodine is an important cause of a certain form of goitre and of its sequelæ, namely, cretinism and hairless disease which is common in certain animals, for instance, hogs and goats. I do not know whether hairless disease occurs in India or not. I have been able to produce cretinism and hairless disease experimentally in animals. In the middle chart, we have an example of another influence of vitamin deficiencies, that is to say, great susceptibility of both man and beast to infection in consequence of those deficiencies. In this particular instance the disease produced was Epithelioma Contagiosum, which is a disease that affects fowls and other birds. As I see the Commission is desirous of ascertaining the extent to which the keeping of fowls could be introduced in this country, I would like to point out that one of the diseases from which they are liable to suffer is Epithelioma Contagiosum and they will suffer from it unless they are properly fed. Here is a chart (marked " N ") which illustrates the complete eradication of goitre from a school in consequence of the researches that have been carried out in my laboratory. The next chart (marked " O ")* shows the effects on the gastro-intestinal tract of faulty food deficient in vitamins. The cross-section of the large bowel is shown here, and you will also see a representation of the normal large bowel, which is provided with a very intricate neuro-muscular mechanism. The specific effect of deficiency of vitamin B is to interfere with this mechanism so that the gut becomes converted into an inert bag which cannot empty itself and becomes subject to disease in consequence. In this chart you will be able to see the differences between the healthy and the diseased colon. Great atrophy has taken in the latter place.

A.767. *Sir Ganga Ram:* Has food anything to do with the increase of tuberculosis?—Dr. Muthu of this Presidency is the great authority on tuberculosis in India, and he is convinced, after having spent a lifetime working on it, that a contributory cause of tuberculosis in this and other Presidencies in India is malnutrition.

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* Not reproduced.

A.768. Is impure air a factor?—This factor comes in; I do not wish to be understood to say that food is the cause of every disease, but faulty food deficient in the vitamins is the foundation on which many diseases are built. Its chief effect is to cause depreciation of cellular function throughout the body; and depreciation of cellular function makes it possible for pathogenic organisms to grow in the body; no pathogenic organism will flourish on healthy vigorous tissue. I want to emphasise strongly that there is no single factor so important to the well-being of any people as a well-balanced, nutritious diet.

I now refer to the chart marked " P." As an outcome of this work, we must, of necessity, come back to the soil. So, in the course of these investigations, I found, for example, that rice grown on the East Coast of Madras and the same rice grown on the West Coast of Madras differed in nutritive quality. I then tried to find out what the cause of that was. I thought it might be due to differences in the soil and one of the first things we investigated in collaboration with the Agricultural Department of this Presidency was the effect of manurial conditions on the nutritive value of wheat. I will give you an example. On this chart one curve represents our basal diet containing no vitamins; the next curve represents the basal diet containing vitamin A; the next curve represents the basal diet containing all vitamins; and the last two curves represent the basal diet *plus* one gramme of wheat which has been grown on soil manured with cattle or chemical manure. One gramme of wheat grown on soil manured with cattle manure gave a rate of growth which is approximately 17 per cent better than that of wheat grown on the same soil with artificial mineral manures. But the point I should like to stress here is this: that whole wheat, however poor it may be, is a magnificent food; it is better than cod-liver oil and marmite put together. Before I leave this subject, I should say that subsequent experiment revealed that the reason why cattle manure wheat is better than chemical manure wheat is because of a deficiency of vitamins in the latter. This chart (marked " Q ") relates to experiments of a similar kind with millet. But the experiments were of a different order. I took first of all a diet of polished rice such as that dealt with on a previous chart. I fed groups of pigeons on this polished rice. Then by adding millets from various sources, I saw to what extent these millets were capable of preventing the animals declining in weight. Here again we find that millet grown on cattle manured soil has a greater capacity for preventing loss of weight than that grown on chemical manured soil. The curious thing in this experiment was that millet grown on soil which had received no manure at all for a long time was actually harmful. The last piece of work which I have been attempting to do, and which is as yet incomplete, I show you mainly to illustrate the extraordinary width of range that this work on nutrition has. This chart (marked " R ") illustrates the results so far of an enquiry into the effect of various kinds of irrigation on the nutritive value of wheat. At present the experiments are incomplete, but there is one point to which I might refer. It has been suggested that continued old canal irrigation reduces the nutritive value of wheat. This experiment has been going on for 75 days and there is no proof that old canal irrigation does influence the nutritive quality of wheat; but the experiments are incomplete and I am not yet prepared to give an opinion with regard to it. That is a very brief outline of the kind of work we are doing at Coonoor.

A.769. *Professor Gangulee:* What about paddy? The irrigation in this Presidency is mostly on paddy?—That I do not know yet; this work has only just begun.

A.770. *The Chairman:* Colonel McCarrison, we are greatly obliged to you for the very interesting account of your work which you have given us. I think we must resist the temptation to pursue you into the thickets of physiological disputation, but I think my colleagues would like to ask you one or two questions based on our terms of reference?—If I may say so, when you did the honour of visiting me at Coonoor, you also asked me whether I would also say something to the Commission on the effect of malnutrition on animals. I am perfectly prepared to do so, should you wish it.

A.771. I think we should like to hear that now?—I can do that very quickly. In these observations I am now going to make, I am not dealing with the effects of an insufficiency of food on cattle; I am dealing solely with the effects of a faulty food, a food which is in itself incapable of fulfilling the functions of food, on animals which do not receive, for example, a sufficiency of minerals in the food. So far, research on stock has been carried out mainly from the point of view of deficiency of mineral elements, while research on man has been mainly carried out from the point of view of deficiency of vitamins. It is a most excellent thing that it should be so, because the result has been that one branch of nutritional research has gone along one path while another branch has gone along another path; and those two paths must eventually meet; it is absolutely necessary that they should converge and go along the same road. Therefore, there is very much that those engaged in nutrition research on animal nutrition can learn from us and very much that we can learn from them. The chief effects on animals so far studied are those due to deficiency of certain mineral constituents in natural pasturage. Animals become poor, small sized, and low milk-yielding in the case of cattle. I showed in the year 1918 that the milk which the cattle produce and the butter which we get from the milk are, in consequence of the poverty and dryness of the fodder, lacking in one of the vitamins, vitamin A. The general effects of deficiency disease in stock animals so far elicited are these: A slow rate of growth in young animals which is due chiefly to a deficiency of calcium and phosphorus. I understand that there are these deficiencies in the soils of Bihar and the West Coast of Malabar, though I know of very little work that has been done on this subject in India. Secondly, the animals are slow to attain maturity. Thirdly, there is a marked tendency for stock to decrease in size; the stock tends to remain at a size which is proportionate to the food available, just as has happened with regard to children in Russia. Fourthly, there is a high mortality, which is due no doubt to increased susceptibility to infection. Fifthly, the milk-yield is low in cows and the quality, that is to say, its vitamin value, is also low. The birth-rate tends to be low; sterility is fairly high. The carrying capacity of cows is reduced, they have poor coats, and they suffer from skin diseases. There is an abnormal craving (*pica*, as it is called) for various things such as bones, a condition which is known as osteophagia. They also eat earth, mud and very often in this country they eat things that are worse than mud. They have a great craving for salt and salt licks. I am not sure whether it is so, but I am told that some of the goat herdsmen in certain parts of India actually take their herds in the morning round the village to play the part of scavengers. I would now like to refer to the effects of specific deficiencies. One of the first of these is want of iron. That gives rise in pigs to a disease which is called McGowan's disease. It is not necessary to go into the symtomology of this disease. Deficiency of iron also causes great emaciation and anæmia, a condition which is common in certain parts of New Zealand. Then, want of iodine also, as I have said, gives rise to goitre and hairless disease, examples of which I have shown you as having been produced in my laboratory. Want of iodine also impairs the capacity of the animal to assimilate calcium and phosphorus, and so the bones become soft. Want of phosphorus in the soil leads to osteomalacia, which is softening of the bones, poor bones, fragile bones, swelling of joints, stiffness of hind quarters and lameness, a condition which in South Africa is called *Styfsiekte*. Want of phosphorus also causes craving for bones. This craving for bones leads the animals to look for bones in decaying carcasses. In these decaying carcasses they find an organism which produces a very virulent toxin which gives rise to a disease known in South Africa as *Lamziekte*. That disease is due to the products of the bacteria which live in the decaying bones; the bacterial toxins are the actual cause of the disease. It is the want of phosphorus that causes the animals to eat these bones. Another cause of disease in cattle is want of salt, chlorine and carbonates. This is a summary of most of what is known at the present time as to the effects of malnutrition in the causation of disease in animals; no doubt there is much more to be discovered if we look for it.

A.772. *Sir Ganga Ram:* What disease would you expect to arise merely from want of salt?—I should expect emaciation and slowness of growth.

A.773. In milk animals does it decrease the quantity of milk?—Now you are asking me of matters of which I have no personal experience, but from the knowledge I have of experimental work I should say it would lower the capacity of the animal to produce milk. In addition to these diseases, there are others which are the result of infection by micro-organisms consequent upon a state of malnutrition. One of these is called Sarcospiridia or scrapie in sheep. Another condition which is common in sheep and goats is pernicious anæmia, a condition which I have succeeded in producing in the laboratory. Finally, there is the condition, which I have also produced, of hog cholera. These are some of the diseases which are known to prevail in other countries consequent on malnutrition; that is to say, consequent on the consumption of a food which is of poor quality. I do not know to what extent they prevail in this country, but I have given you the list so as to emphasise the very great importance of research on animal nutrition. It is necessary to ascertain to what extent these diseases do prevail in this country.

A.774. *Sir Henry Lawrence:* Is nutrition work on similar lines being conducted in institutions in Europe?—Yes, very largely.

A.775. Where?—Well, of course Cambridge is the centre of it. Sir Gowland Hopkins is the father of modern nutrition, and his work is being carried on there with great vigour. It is also being done at the Rowett Institute in Aberdeen and at the Lister Institute in London. No doubt there are other places which escape my memory at the moment. There are at least four or five centres of nutritional work in England alone where the population is something like one-sixth of what it is in India.

A.776. *Sir Ganga Ram:* What are the journals or pamphlets in which they publish the results of their labours?—All the work done on behalf of the Indian Research Fund Association is published in the official journal of the Indian Research Fund Association.

A.777. *Mr. Kamat:* Are not the Japanese also doing this kind of research?—Yes, they are.

A.778. *Sir Henry Lawrence:* And in the United States?—Very much.

A.779. The Rockefeller Institute has taken it up?—The Rockefeller Institute has not done so much as McCollum at the Johns Hopkins Institute. When I was in America I was greatly impressed by the work that was being done, especially at the Johns Hopkins Institute. McCollum is of course one of the chief names in connection with this work; his book on the subject is one of the standard works.

A.780. And in regard to nutrition work on animals are there similar institutions? There is one just being started in Edinburgh, I think?—Yes; and there is one which has been going in Aberdeen for some years, which has been doing good work.

A.781. Do they carry on experiments on rats and other animals?—Most of the work on human nutrition is done on rats because the rat is an omnivorous animal, and the life of the rat being short one is able to study it from the day of its birth to the day of its death, a comparatively short period of time. If we had to use larger animals, such as monkeys, it would be impossible to get the work done in a reasonable time. All that has been found out with regard to rats has been shown to be applicable to man.

A.782. It has been established that the results obtained from rats are applicable to man?—Yes. For instance, the work on rickets has been done on rats and dogs, and it has been directly applied to the great benefit of humanity.

A.783. In the greater part of India, is there a sufficiency of milk in the diet?—I wish to be very guarded in any answer I should give you, because my experience is mainly a laboratory one; but from what I know, I should say that there is not nearly enough milk in the diet of the people except in that of some of the better class people in the north of India. There is certainly not nearly enough milk and milk products in the diet of the Southern people.

A.784. The superior physique of certain races in the north may be connected with their having a larger provision of milk in their diet?—It is connected with it, that is my opinion. I should say it is due to the combination of whole wheat, milk and milk products.

A.785. You attach a considerable value to the item of milk?—Very great importance.

A.786. Therefore it follows that one of the greatest problems of India is to secure sufficient provision of milk in those Provinces where it is now deficient?—That is so.

A.787. You attach great importance to that?—Very great importance.

A.788. You have mentioned the case of goats being fed in the surroundings of villages. Cattle also eat excreta?—Yes, I have seen them do it.

A.789. Does that have a deleterious effect on their milk?—That I do not know from personal experience, but I should imagine it would.

A.790. It would be possible to ascertain that?—Of course, anything is possible of that sort, provided we have the means to do it, the laboratory facilities and the staff.

A.791. It would not be without a certain value, for I have known a town which depended for its sanitation on the cattle eating excreta, and it was definitely put forward by the municipal council as being the best form of sanitation that they could think of. You would not agree with that?—It is certainly one way of carrying on conservancy work, but what the effect would be on the cattle would be a very interesting thing to find out, because if they were at the same time deficiently fed they must suffer from all sorts of infections, infecting themselves from the excreta.

A.792. And that infection may be passed on to the milk?—Certainly, it might quite well be so.

A.793. It might be a very important subject for investigation?—It might, yes.

A.794. Amongst the results of malnutrition can you trace sterility?—It has been so traced in other countries and as a matter of fact the first reference to it emanated from my own laboratory. In feeding animals in this way on diets extremely deficient in vitamin B, I noticed in 1918 that atrophy of the testes was one of the earliest effects. During famines and war, sterility in women and failure of the menstrual function have been recorded as evidence of malnutrition. Which of course was half-starvation also.

A.795. From that it would follow that any section of the population who suffer from half-starvation would be deficient in reproduction?—Not necessarily so, because it depends upon the respect in which their food is deficient. For example, in order to produce that effect their diet must be deficient in a vitamin which is now being called vitamin E. Vitamin E is quite abundant in such things as wheat, paddy and other cereal grains and in green leaves, meat and fats; in fact it is in cereal grains that it is chiefly found; so that I would expect to find sterility more common in people who are subsisting, say, on white bread, than I would in people who are subsisting on a home provided paddy diet.

796. *Dr. Hyder:* Taking the case of Eskimos, I would imagine that they would not eat much cereals?—No.

A.797. And I think with them there probably is a diminution of this power?—That race is said to be dying out to a considerable extent; but there are many causes. One of them is infectious diseases, tuberculosis and so on. But all these vitamins are so widely distributed in nature and in flesh foods that Eskimos who would be eating blubber would probably get plenty of them.

A.798. That would be fat?—Yes.

A.799. Do you think vitamin E would be present in blubber?—I should think it would, but I have never investigated that substance.

A.800. The Eskimos live in a part of the world which is not very populous?—Their food of course is very limited in choice.

A.801. *Sir Henry Lawrence:* We were just discussing the malnutrition which appears to exist in the paddy diet. In that diet there is vitamin E?—Yes.

A.802. So you may possibly find a combination of an excessive power of generation with a serious condition of starvation?—I could not answer the question; I have not got enough information.

A.803. It might possibly result?—I should hardly say excess of power of reproducing the race; but I should say, more properly perhaps, very little impaired capacity to reproduce the race might exist with certain forms of malnutrition.

A.804. But we are finding at the present time, are we not, that there is an excessive power of generation among the C.3 population?—Apparently that is so, but I myself have not studied the subject.

A.805. Is it possible that any particular kind of diet may lead to sterility?—Yes, that is quite possible. Diets which are deficient in vitamin E, for example, will certainly lead to sterility.

A.806. It can be induced?—It can be induced in the laboratory; I can induce it myself at will; sometimes I find that my rats reproduce more quickly than I can deal with them; what I do then is simply to reduce the amount of milk and butter which they are getting and they stop breeding, or at least they do not breed so fast.

A.807. *Sir Ganga Ram:* Has the nature of food anything to do with the disparity of male and female births?—I do not know.

A.808. Have you ever studied that?—No.

A.809. The disparity is so great in different Provinces?—Yes.

A.810. In the Punjab, for instance, the percentage of male population is much more than that of female population?—I can quite see that you would be very interested in extending the study of nutrition in this country. At this meeting I am receiving many suggestions from the various Commissioners which emphasise the great importance they attach to the extension of this work.

A.811. You say there is want of calcium and phosphorus in the diet of cattle. Would gypsum be of any use?—I should have to refer you to the veterinary people for that sort of information. I have just made a summary of the diseases from which cattle suffer for your information.

A.812. Does manganese exist in any other cereal which can be eaten with rice?—Yes, it is very widely distributed in nature. If you are interested in it I can tell you where it occurs: it occurs in cabbage leaves, turnip leaves, asparagus tops, leeks, garlic, onion; fruits: orange, lemon, strawberry, while whole wheat is particularly rich in it. Wheat bran contains as much as 3·9 milligrammes per 100 grammes. Estimations in my laboratory have shown whole wheat to contain 4·82 milligrammes per 100 grammes. It also occurs in animal tissues, especially in the organs of chief functional capacity like the liver, pancreas, lymph nodes, kidney, muscles of the heart, brain and lungs. In connection with its occurrence in the pancreas, it may interest you to know that it also occurs in the active principle of the pancreas, insulin. Diabetes is an extremely common disease in this country and it is quite possible that the further study of the relation of manganese to the functional perfection of the pancreas may throw great light on the subject of diabetes.

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A.813. Can deficiency of iodine be made up by any specific vegetable?—Yes, it can be made up. It is a curious thing about these substances which exist in very small amount in foods (vitamins, manganese and iodine) that they are all found to have more or less the same distribution in plants, so that if a man eats plenty of green leafy vegetables and whole wheat, he is not likely to suffer from iodine or other deficiency.

A.814. When you say green leaves, do you mean boiled or raw?—So far as iodine is concerned, it does not matter whether they are raw or boiled. Perhaps better eaten in the raw state.

A.815. I was told that iodine occurs very largely in some herbs in the Himalayas?—There is very little iodine in the soil of certain Himalayan regions. There is a good deal of iodine in the soils of the Nilgiris.

A.816. *Sir Thomas Middleton:* You mentioned mineral deficiency in certain parts in India, Bihar and Malabar. Were these deficiencies ascertained by yourself?—No. I learnt about the deficiencies in Malabar from Mr. Viswanath of the Agricultural Department of the Madras Government. With regard to the deficiency in Bihar, I found a reference to it in an article published in the *Agricultural Journal of India* in about 1917.

A.817. You agree that almost nothing is known about mineral deficiencies in India?—Apart from the work which Mr. Warth is struggling so courageously to do at Bangalore there is no work so far as I am aware being done on this subject. I have recently visited Mr. Warth and I am very greatly impressed not only by the magnificent work he is doing under very difficult circumstances but by the great necessity for the extension of his work on the lines laid down by him.

A.818. You are aware that Dr. Orr, who has specially worked on this subject, has indicated the great danger of mineral deficiency in the rapidly growing animal?—Yes.

A.819. Does that suggest to you that if we in India are quite ignorant as to the extent of mineral deficiencies, there may be some danger in attempting to increase the size of our stock rapidly by improving the bulls?—Yes; it will be largely labour lost, because you may get an improvement in the first generation and thereafter the cross-bred stock will most certainly deteriorate.

A.820. Is there not a great danger of death in the first generation?—There is, I am speaking now from memory; I seem to remember having read that the mortality among these cross-bred animals is very much higher than the mortality in the country-bred animals.

A.821. That is the particular point to which Dr. Orr drew our attention, in the recent report on Kenya?—Was it?

A.822. You said in connection with livestock much more work has been done on minerals than on vitamins?—Yes.

A.823. Is it not the case that Dr. McCollum started the work on minerals and then went on to vitamins?—Dr. McCollum originally started with food mixtures generally; vitamins were only discovered shortly before the War.

A.824. Within the last eight or ten years a great deal of work has been done?—He first started with minerals and then went on to vitamins.

A.825. In Great Britain have you heard of the work of Drummond, Zilva and Golding? They are working on domestic animals?—They are.

A.826. In fact the work on vitamins was much more substantial in volume than the work on minerals until within the last two or three years?—Within the last few years, especially in 1925, there has been a great output of work.

A.827. Investigators originally began working on vitamins and found that sometimes vitamin was not as important a factor as minerals; they switched on from vitamin to minerals about 1923?—Quite so.

A.828. Is it now definitely accepted that vitamin E does exist?—It is a recent arrival in the vitamin field; it has been accepted.

A.829. You do not suspect that it is vitamin B?—My own definition of 'vitamin' is a wide one; I mean by it all those substances in food which exist in very small quantities whether they are organic or inorganic of which we do not yet know the action.

A.830. You have no proof as yet that old canal irrigation affects the quality of wheat?—Not as yet. It is with regard to loamy soil that I made that statement.

A.831. If we get such results as have been got by you and Dr. Norris in Coimbatore, it is difficult to accept the view that canal irrigation would not have an effect upon the quality of the crop?—You think it would have an effect?

A.832. Yes?—As I said, this work is still in progress.

A.833. Indirectly through its effect on the mineral constitution of the soil?—Obviously the quality of the soil and the kind of soil are going to have a great effect. We are going to find, I think, different effects on loamy soil and sandy soil.

A.834. You used one very illuminating word when you were talking of the addition of vitamin or the need for vitamin; you referred to the "spark" of the vitamin being wanted to make the rice effective. I think the illustration is a familiar one. Would you agree that if we use the metaphor of the car we might compare the effect of the rice to the influence of the petrol in the working of the car and the vitamin to the sparkling plug?—That is what I said.

A.835. Then, you agree that provided the rice has the necessary addition it is a most valuable food?—Yes.

A.836. Would you agree, to use a common phrase, that one of the reasons why wheat is so much more valuable universally than rice is that the one is more or less a fool-proof food and the other is not?—That is a very good expression. Whole wheat is a fool-proof food. The energy value of rice and wheat in equal amounts is precisely the same. For instance, one ounce of rice has a calorific value of 104, whereas one ounce of wheat has a calorific value of 103. But the difference in the nutritive value of the two grains is enormous.

A.837. *Sir Henry Lawrence:* If a man eats wheat he will find all the necessary elements for his nourishment provided he takes milk. But if he eats nothing but wheat he also will get ill?—Yes. In much the same manner as if you give the engine of your car petrol but not enough oil it will get out of order. Similarly if you give a man only wheat, you will cause him to get ill. You must have a natural balance in all these things. One of the great troubles in this country is that people cannot provide themselves with the other substances to make good the deficiencies of rice.

A.838. If you have to put in this natural balance, I do not understand what you mean by "fool-proof?—Wheat is in itself fool-proof; but it does not in itself constitute a complete food.

A.839. You cannot injure it?—No, unless by making it into wheat flour.

A.840. *Sir Thomas Middleton:* Is it not the case that the feeding of cattle and goats on village refuse is usually accepted as a proof of mineral deficiency?—It is usually.

A.841. So that wherever such a state of affairs is common the position ought to be closely investigated?—It ought to be; it is certain that there is a deficiency.

A.842. *Dr. Hyder:* I want to put a few practical questions with regard to this matter of nutrition. You said to the Chairman that you had no one to whom you could hand over your work. I wonder whether you are acquainted with the internal working of Indian Universities. Supposing our M.Sc.'s in Bio-chemistry, medical graduates, or agricultural graduates, were placed under you for training, could you initiate them into the methods of research, and go away with the confidence that they would carry on your work?—Do you ask me whether I could do this?

A.843. No. I ask whether you think that graduates who come out of our Universities with Degrees in Bio-chemistry, Physiology or Medicine could undertake work of the kind which you are carrying on?—My present opinion of such Indians as have served under me is that nutritional work particularly appeals to them, and personally I would be hopeful that amongst, say, every hundred men, who would pass through my laboratory there would be seven or eight who would be capable of undertaking original research in nutrition. I should not expect to find very many more. But those hundred have not passed through my hands, and until you see a man working, how he shapes and what thoughts arise in his mind when he sees a piece of work in front of him, you cannot say how he will turn out.

A.844. Is the University of Madras taking interest in your work?—I know that the medical profession of Madras generally takes a very great deal of interest in this work.

A.845. I wonder whether they have a Chair for Bio-chemistry in the University of Madras?—I do not know whether there is or there is not at the present time, but a Chair for Bio-chemistry is a very important addition to any University.

A.846. Passing on to another point, you know that some Indians have taken to European modes of living. I was wondering whether they were not after rising from one pit going to fall into another pit?—Many of them would be out of the frying pan into the fire.

A.847. You know that lemons are very largely used in this country. As soon as people become Europeanised they take to aërated waters, such as lemonades, and tinned foods, and also perhaps to polished rice. I was wondering whether the higher incidence of disease among educated Indians was due to their adoption of European ways of living?—In answer to this question I would say that each Commissioner who cross-examines me suggests other lines of nutritional research. In order to answer your question, it is necessary to extend the facilities for the investigation of such nutritional problems.

A.848. For instance, healthy and big-boned students from the north who come from their villages and are drafted into these colleges and Universities lose their vitality; that is my experience as a teacher in a Northern University. I was wondering whether the change was due to their adoption of European ways to some extent?—That is one of the things which we will be very happy to ascertain for you provided you give us your help to start an institute of nutrition.

The Chairman; Probably Dr. Hyder may be content to know that it may not be due to their adoption of European customs; there may be deficiencies in their diet not necessarily present in European diet.

A. 849. *The Raja of Parlakimedi:* You say beriberi is confined entirely to the East Coast of this Presidency; is it because it is a rice eating area?—Yes; beriberi occurs only within about 45 miles of the coast in the rice growing areas; it exists in the North East Coast of this Presidency, from Ganjam downwards.

A.850. There are, of course, favourable climatic conditions for the production of the disease?—The climatic conditions are certainly favourable for its production.

A.851. Have you got the full history of the beriberi disease?—We have succeeded during the last year in producing true beriberi in my laboratory; we have had 175 cases of it produced in animals, and I think now we can safely say that we know a great deal about it; we certainly know how to prevent it but whether we shall be able to find the actual causal factor of the disease remains to be seen. It is not a matter of very great practical importance. Whether we say that beriberi is due to an undiscovered substance X and whether we find that substance or not, we certainly know how to prevent the disease.

A.852. Is there any objection on the part of the department to have all that published in the vernaculars?—No; I think that is one of the reasons why the work on this subject should be extended; there should be a Publicity Department as part of a Department of Nutrition. All these things which we ascertain in the course of our work should be put into simple language and widely published in the vernacular papers.

A.853. Can it be undertaken by any private individuals on application?—I should think it can be; I do not see any reason why it should not be, but that is a matter, of course, for the authorities concerned to decide.

A.854. *Sir James MacKenna:* I understand you are of opinion that the work you are doing at Coonoor and the work that Mr. Warth is doing at Bangalore and the work that is being done at Coimbatore on nutrition should be linked up?—Yes.

A.855. Would you like that work concentrated in one institute?—Not necessarily so.

A.856. You think it is possible to work up a link between the three existing agencies?—Yes.

A.857. Or would you prefer to have the whole thing under one roof?—I do not see any particular point in that; there is more room for expansion of the work as it exists at present than if all the three were situated in the same building. For instance, work on animal nutrition would have to go on being done in Bangalore, as there is no space for it at Coonoor. The work on human nutrition would have to go on being done in a reasonably good climate, because after all the output of work is entirely dependent on the man doing it, and he will do much better work if he is in a reasonably good climate than he will if he is in a bad one; that is the reason why I am doing my work at Coonoor; it would not suit me so well to do it elsewhere.

A.858. You would not like to have a central institute on nutritional research which would be working through all these three branches as at present?—Yes.

A.859. The relations are apt to break down if we merely link them up; you would have no objection to calling it a central institute on nutritional research working in all these three branches?—No.

A.860. Have you sufficient work for yourself and a full-time Bio-chemist?—I have sufficient work for half a dozen Bio-chemists.

A.861. You emphasise the very considerable possibility of getting capable young Indians to carry on this work, but the facilities for teaching would not be so great if the work is scattered in different places as they would be if you had a central institute?—Any young Indian taking up this work would have to take up one department of it; if he came to me, for instance, to do human nutrition, he would probably stick to it for the rest of his life; he could always visit the other centres and see what is going on there for educational purposes.

A.862. From that point of view, a scattered arrangement would not be any good?—I do not think so; it is an important matter for instance to extend the work at Coonoor. The jam factory is a building I wish to acquire, because, as I told the Chairman, it is very suited for work on nutrition, and it has been suggested to me by the Director of Agriculture of the Madras Presidency, that it would be an excellent thing if the work which Mr. Viswanath and myself are doing could be carried on by a Bio-chemist of the Agricultural Department, who, if he had the buildings of the jam factory, could do so under my direction.

A.863. The moment you have the jam factory, you begin by pooling in that place one of the connected branches of the work?—Not quite that. Their idea is that it would take the man a good year or more to learn how to do these experiments; it is not merely a case of having half a dozen rats and putting them in a cage; there is a great deal to learn, and what he would do, would be to learn himself and so teach others. That would be a means of spreading the work, so that routine testing of vegetable foods by biological assay could then go on being carried out by an Agricultural Chemist in other parts of the Madras Presidency.

A.864. Assuming that you do get the jam factory, you would still retain Coimbatore and just extend your own operations?—Yes.

A.865. *Professor Gangulee:* Apart from diseases that actually break out owing to deficiencies in diet are you of opinion that any such deficiencies leave the body defenceless against other diseases? I mean the response of the body to immunisation?—That has been definitely proven.

A.866. From that I gather that nutrition investigation will throw much light on preventive medicine?—Yes.

A.867. You said in answer to a question put by the Chairman that you are the only research worker in India in this nutrition investigation?—Yes, that is so.

A.868. And this subject of medical research is directly under the Government of India now?—I am working for the Indian Research Fund Association which, I believe, is a private fund, and it is contributed to of course by the Central Government.

A.869. I know; apart from the research fund that you are referring to, the whole question of medical research is under the Government of India directly. I mean the question of medical research as a general subject apart from the Indian Research Fund Association?—There is no other research financed except by the Research Fund Association, so far as I am aware.

A.870. It is rather difficult for me to understand why the Government of India has not taken adequate interest in that work; is it lack of equipment or lack of interest?—How do you mean the Government of India has not taken an interest?

A.871. Because, you say you are the only research worker in India?—The Government of India, I take it, has got other fish to fry as well as nutrition research.

A.872. Do the medical officers belonging to the superior grades receive training in research work in dietetics? Do those of them who come over to this country get any training?—If you mean young members of the I. M. S., nowadays they get intensive training.

A.873. Before they come over to this country?—Yes.

A.874. It is not lack of trained men? We can get trained men for the purpose, if you have the institute?—You can get men who know their A. B. C., they can read, so to say; no man is trained until he has been through the mill and attempted to do the work himself. Research itself is difficult; what I mean is that there are several kinds of research; the man may simply follow in the lead of somebody else.

A.875. And cannot take the initiative?—Yes. For research in this country we want men with imagination and capacity for initiating it.

A.876. Do you suggest that such workers cannot be found in the superior grades of the service?—No, I do not suggest anything of the kind. I consider still that there is no function of medicine which cannot be fulfilled by officers of the service to which I have the honour to belong.

A.877. Do the Government of India send men abroad, either to America or Japan, for training?—They sometimes do.

A.878. In 1923, I understand the Rockefeller Foundation made an offer?—Yes.

A.879. And the Rockefeller Foundation is an international organisation?—Yes.

A.880. Willing to co-operate with any body in any country for the purpose of training in this sort of nutritional research. Could you tell the Commission what the Government of India has done to avail itself of the unique facility offered by this international body?—That, I am afraid, I cannot answer, because I have not had any experience of the Secretariat of the Government of India, and I do not know what they have done in the matter.

A.881. You are aware of that offer?—I can aware of it.

A.882. I think three men were sent from this country?—Were there three sent?

A.883. To the Johns Hopkins University; what happened to these men when they returned?—I do not know; I think one was Major Shokey, he is now at the Haffkine Institute.

A.884. You are not aware of the conditions on which the Rockefeller Foundation made these offers?—I am not.

A.885. There was a proposal by the Government of India to start nutrition work in this country, and it was suggested to secure the services of Professor Saiki of Japan; are you aware of that?—I have heard that something of the sort was suggested. His services are quite unnecessary.

A.886. Could you tell the Commission at what stage the proposal now rests?—I do not know at what stage the proposal now rests; I know I have not succeeded in finding the name of Dr. Saiki mentioned in nutritional literature.

A.887. He is, I think, Director of the Imperial Institute in Tokio?—Yes.

A.888. Is there any definite proposal before the Government of India with regard to your work, either for its expansion or for its cessation?—One sends up one's proposals for the next year in the usual way; that is all one knows about it.

A.889. You are assisted in your work by a number of Indians?—I have three assistants.

A.890. Are you satisfied with them?—All of them are most admirable.

A.891. Can they do the statistics work well?—They cannot, but I have had the advantage of having the services of the Director of Public Health's Statistical Assistant, who has given me most valuable assistance.

A.892. Which are the most important from the point of view of deficiency, vitamins or glands?—I cannot say. Comparisons in regard to substances essential for metabolism are difficult. They are all equally important.

A.893. What are the criteria of a good diet?—It is a general question. The diet should be perfectly balanced in respect to proximate principles of the food which are proteins, carbo-hydrates, fats, salts, and water. It also should contain a sufficiency of vitamins without which, as I explained, the normal processes of metabolism are impossible. Those are the criteria of a good diet.

A.894. One word about this Indian Research Fund Association to which you made reference. In what sense do you think it may be designated as semi-official body or organisation?—I believe the Government of India contribute largely towards it. I understand it has a scientific advisory board, and the governing body of the Indian Research Fund Association has a number of officials working on it.

A.895. In the governing body, I do not find a single non-official. Does it consist of officials only?—I do not know. I am not familiar with its constitution, perhaps not so familiar as I ought to be; but to tell you the truth, I have not thought about it.

A.896. *The Chairman:* They send you the money and you do the work?—Yes.

A.897. *Mr. Calvert:* Are you in a position to venture an opinion as to how far poverty enters into this question of nutrition?—I am not in a position to do so. It is outside my kind of work.

A.898. Ordinarily one would expect that unpolished rice should be cheaper than polished rice and white flour?—Yes. But if people bought *atta*, they would not be doing themselves an injury, because *atta* is the better of the two.

A.899. In the case of the army rations, I think the rice eater's ration is actually more expensive than the *atta* eater's ration?—Yes.

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A.900. In the case of a man not necessarily affected by poverty, it is a question of unsuitability of the actual diet?—Yes. Many of the better class of people in England feed themselves unsuitably.

A.901. Have you made a study of the food consumption by cultivators in the special tracts of the Punjab?—I have not.

A.902. There was an enquiry by a Colonel of the Indian Army Service Corps, the Inspector-General of Prisons, the Superintendent of the Mental Hospital and a Professor of Physiology, who discussed the dietary from various points of view. Do you think similar enquiries into the dietary of the rural classes would be of any help?—Yes, of immense help.

A.903. I see the army ration scales have been worked out to give a complete ration, with vitamin values also. Is that scheme approved by you?—It has not come to me for approval.

A.904. It was issued by the Director of Medical Services?—It has not come my way.

A.905. In answer to a question from Sir Henry Lawrence on this question of milk, you said that milk was a very important item; but in a very large tract of country in China, Japan, Burma and Siam, milk is not part of the diet at all. How do you reconcile that with your remark about milk?—I should imagine that the people in the tracts you refer to are not of good physique or that they use other foods, such as fish, which may to some extent compensate for the want of milk. For instance, in Japan there is more beri-beri than probably in the rest of the world, all the countries put together. Obviously, Japanese do not receive enough protein; otherwise, they would be bigger people.

A.906. You say that milk is very necessary; but still the Japanese and Chinese as a race have been in existence for some thousands of years?—There is no reason why they should not continue to exist but their physique is smaller.

A.907. The constitution of the Burman may be due to his not taking milk?—Yes. None of those countries are very healthy countries.

A.908. Is *dal* not an adequate substitute for milk?—Not for milk. It is an excellent substitute for mutton. It does supply a sufficient amount of protein; there is no substitute for milk.

A.909. *Dr. Hyder:* Have you ever seen a tall Japanese or Chinaman?—I have never been either to Japan or China.

A.910. *Mr. Kamat:* As national habits of diet cannot be changed in a day, I should like to know what advice, for instance, you would give to the Madras people to attain the same efficiency as the Punjab people, say, for example taking more pulses and *dals* in their food, for the time being?—The answer to that is this: that there is only a certain amount of pulse or *dal* which they can take. Everything over about 4 ounces of pulse will be useless. They cannot deal with it. The protein which the pulse provides they cannot assimilate. So it will remain in the intestines and will give rise, as Colonel McCay showed 14 or 15 years ago, to another sort of disease. So, even with the pulses there is no hope for them to rise to the same standard of physical efficiency as in the Punjab. If, however, they consume more milk and green vegetables, then they can attain a reasonable state of physical efficiency.

A.911. I want to know also the value of pulses *versus* meat. Can those, who do not touch meat and depend on pulses, have the same efficiency as meat-eating people?—Provided the rest of their diet is complete, provided they take a sufficient amount of milk, they will do admirably on pulses.

A.912. So the whole question comes back to milk?—Yes, it comes back to milk and to the balance of food.

A.913. *Mr. Calvert:* But milk is not part of the army ration?—The men get *ghi* in its place.

A.914. *Mr. Kamat:* There is just one question about publicity. Would it be possible to embody your results into school text-books in simple language, including also the charts on a small scale?—It would be quite possible. In the institute of nutrition, which we are all thinking about, there will be some man who will be specially engaged in the production of these pamphlets, because it will take a man all his time to do it. It would not be possible for me.

A.915. With Indian assistants?—Yes.

A.916. For the benefit of the succeeding generations?—Yes, to the great benefit of India.

A.917. What is the amount of the annual grant made from the Indian Research Fund roughly?—I think including my pay, I get about Rs. 70,000 per year.

A.918. And if you want more money, I believe it will be available from this Fund?—When I have been actually working for the Fund I have not so far been stinted for money for my researches.

(The witness withdrew.)

The Commission then took oral evidence of Major-General F. H. G. Hutchinson for which see Volume III and then adjourned till 9-30 a.m. on Monday, the 30th November, 1926, in Calcutta. For the proceedings of meetings from 30th November to 7th December 1926 (excepting the evidence of Dr. E. H. Pascoe which follows), see Volume IV.

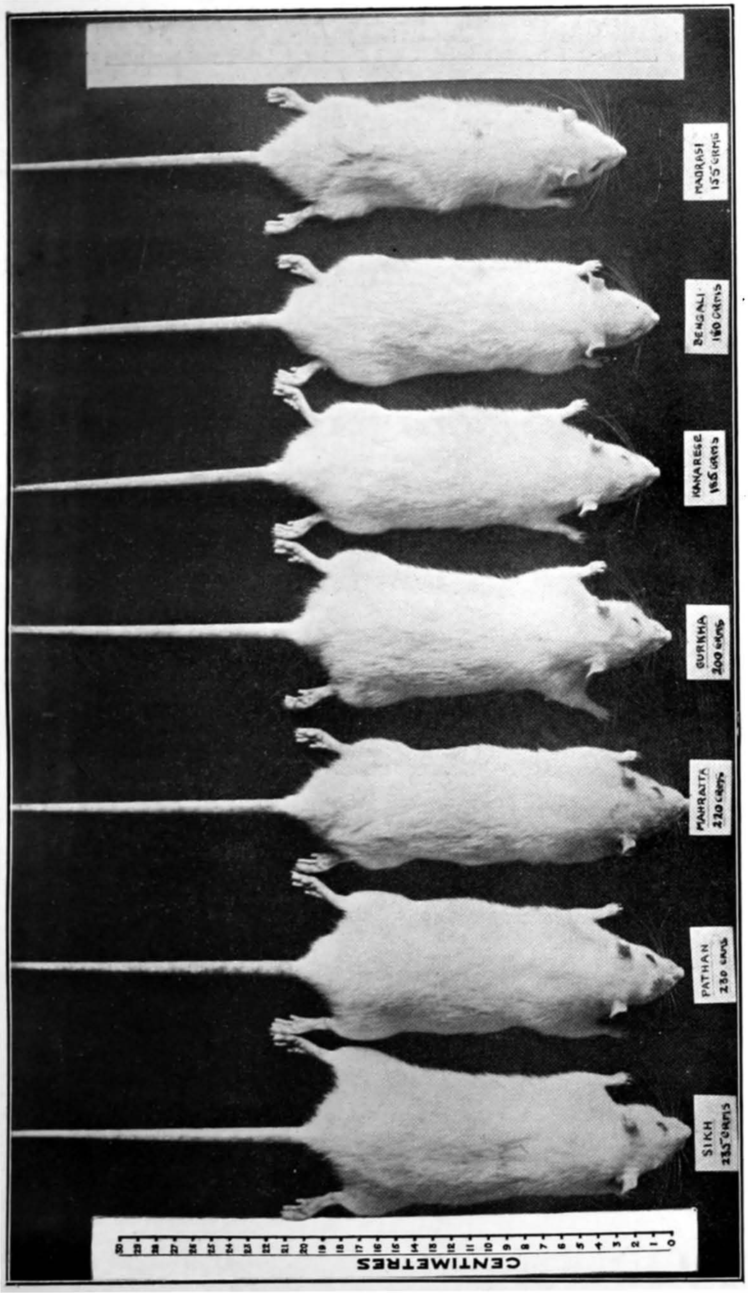
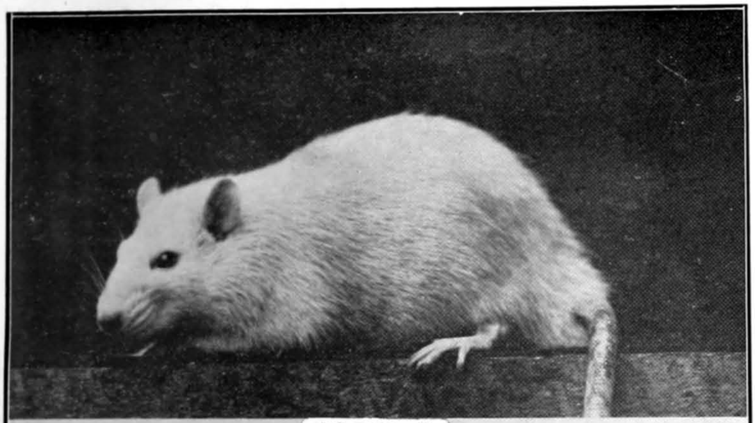

MADRASI 155 GRMS
BENGALI 160 GRMS
KANARESE 185 GRMS
GURKHA 200 GRMS
MAHRATTA 220 GRMS
PATHAN 230 GRMS
SIKH 235 GRMS
CENTIMETRES
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

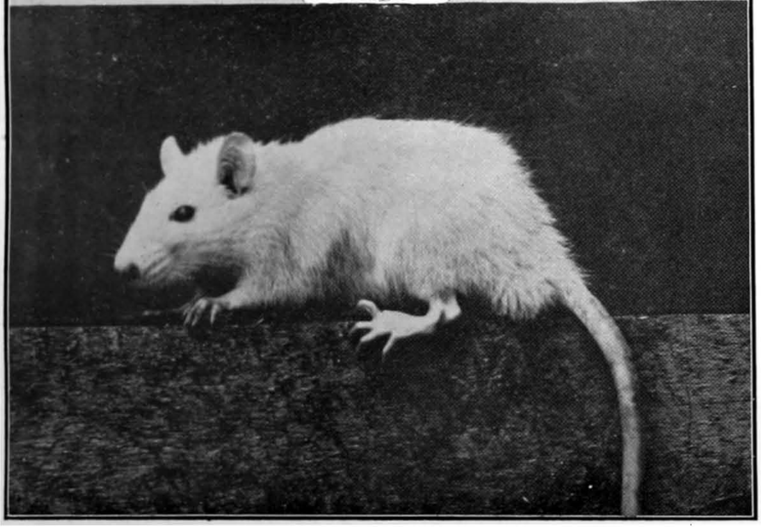
Fig. 1.

Shows the relative values of certain National diets of India (*vide* text of Evidence on page 101 and Chart E). The rats selected represent in each case the *average* weight of the animals in their particular group. Photograph taken on the 140th day of the experiment. Compare Chart E showing the percentage increase in body-weight on the 80th day of the experiment.

Lieut.-Col. R. McCarrison.



"Good Diet"



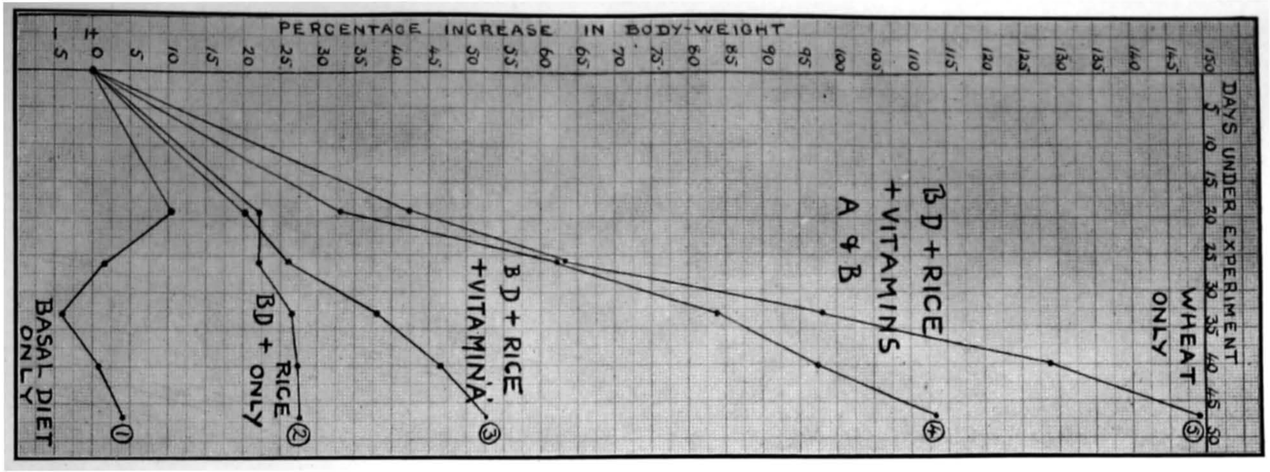
" Bad Diet "

FIG. 2.

Shows the effect on rats of a " Good diet " and a " bad one." The former was such as is used by the Sikhs; the latter such as is used by many Europeans of the poorer classes (*vide* text of Evidence on page 102). The latter diet is no better than the diets of Bengal and Madras; in some respects being worse.

Lieut.-Col. R. McCarrison.

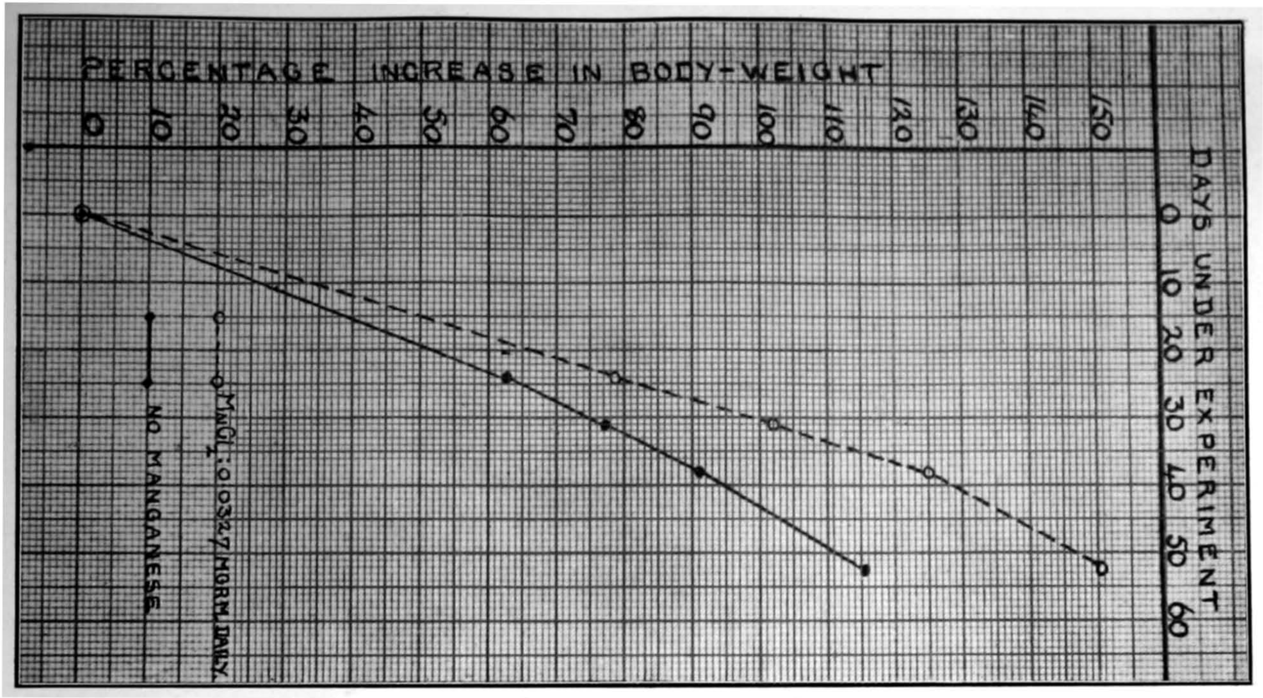
CHART B.



Five groups (six in each) of young rats of the same initial weight, age, sex, and growth potential, were fed on a basal diet containing proteins, fats, carbohydrates and salts in proper amount and proportion but without vitamins. One ① received this diet only; a second ② this diet *plus* one gramme of *whole rice* as the sole additional source of vitamins; a third ⑤ received the same diet *plus* one gramme of *whole wheat* as the sole additional source of vitamins. Note the remarkable difference in nutritive value between whole rice and whole wheat. The addition of vitamin-A to the diet containing whole rice ③ did not improve it greatly, while the addition of both vitamins A and B did ④; thus demonstrating the fundamental poverty of whole rice in these two vitamins. This addition did not, however, make the diet containing rice equal to that containing wheat. The reason being that rice is also poor in certain inorganic salts, notably manganese.

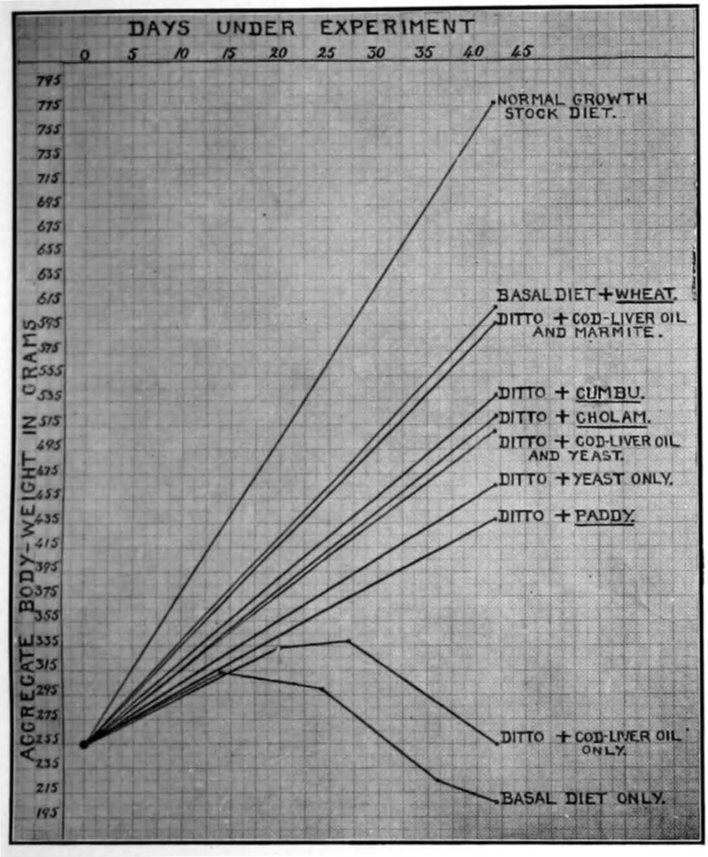
Lieut.-Col. R. McCarrison.

CHART C.



Two groups (six in each) of young rats of the same age, sex, initial weight and growth potential, were fed on a synthetic diet complete in every respect as regards proteins, fats, carbohydrates, salts and vitamins. But to the diet of one group manganese chloride was added in amounts proportionate to that present in a wheat-eater's diet. The pronounced effect of this small amount of manganese on the growth of the young animals is seen in the chart (in this and in all other experiments the similarity in growth potential was ensured, as far as possible, by selecting the animals for each group from a number of different litters).

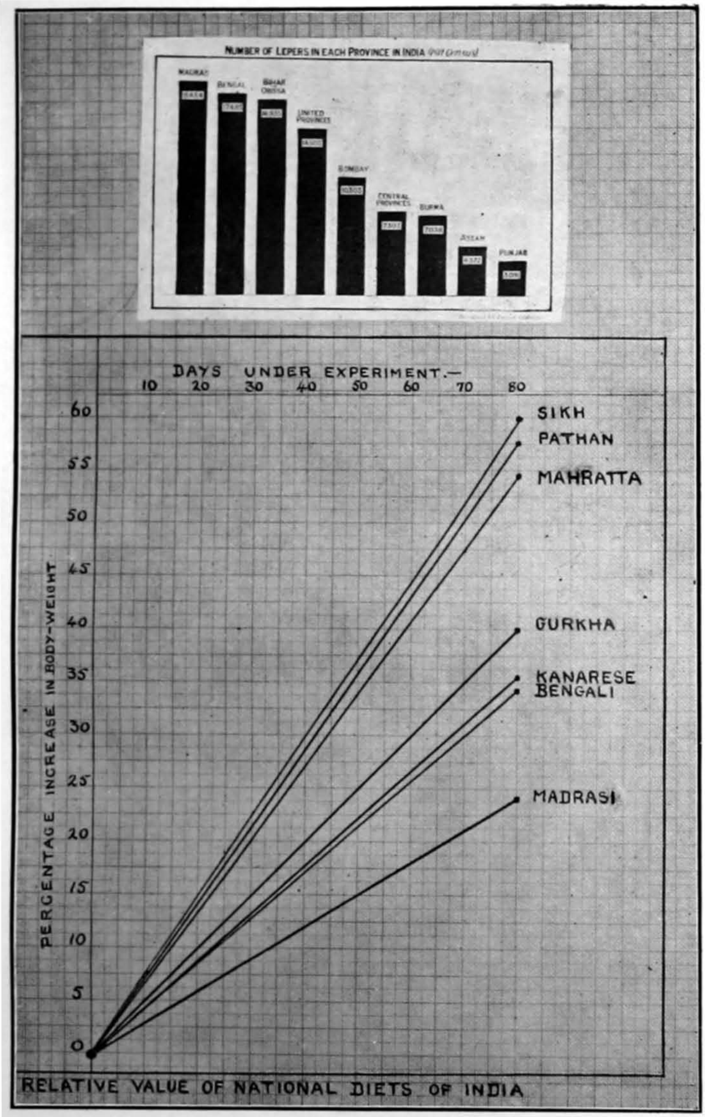
CHART D.



This shows (1) that no growth results from a basal diet which contains no vitamins although it is complete in all other respects (lower curve); (2) that the addition of cod-liver oil to this diet—which provides vitamin-A—does not improve matters much (second curve); (3) that the addition of cod-liver oil and yeast which provides both vitamin-A and vitamin-B does result in fairly good growth (fifth curve), this growth being better still if the source of the vitamin-B is marmite instead of yeast (eighth curve); (4) that the addition of yeast alone (fourth curve) gives almost as good growth as yeast and cod-liver oil (fifth curve) showing that the olive oil used in the basal diet contained some vitamin-A; (5) that when one gramme of wheat or *cumbu* or *cholam* or paddy was added to the basal diet as the sole additional source of vitamins, wheat was found to be by far the richest in those substances so necessary for growth, and paddy by far the poorest; while the other two grains occupied an intermediate position in this regard; (6) that one gramme of wheat gave as good growth as cod-liver oil and marmite put together and better growth than cod-liver oil and yeast and (7) that no artificial diet was as good as the natural "stock diet" used which consisted of *chapattis* of *atta*, sprouted grain, milk, butter, green leafy vegetables, fruit, tubers, roots and fresh meat once a week.

Lieut.-Col. R. McCarrison,

CHART E.



Seven groups of twenty young rats of same initial weight, age, growth potential, and sex, were placed in separate cages and under precisely similar conditions of life. Each group was fed on a diet such as is used by the race the group represented. The diets of the wheat-eating races—Sikhs, Pathans and Mahrattas—were the best, in conformity with the fine physique and military history of these races. The diets of the rice-eating races—Bengalis and Madrasis—were the worst, in conformity with their smaller stature or poorer physique and poorer capacity for hard work. The addition of such articles of food as milk, butter, meat, etc., greatly improved the rice-eater's diet. Contrast, for example, the Madrasi's diet with that of the Gurkha (the latter eating meat more frequently). The Kanarese are millet (*ragi*)-eaters; the Mahrattas use half rice and half wheat or *bajra* with milk and milk-products. The upper chart shows the much higher incidence of leprosy in the more poorly nourished races.

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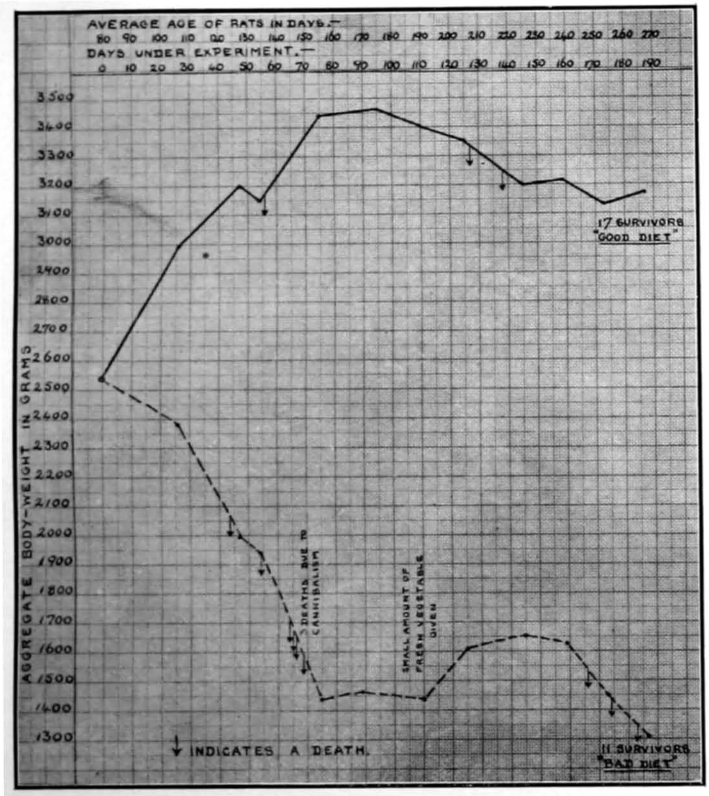
CHART H.



This shows the difference in nutritive value and health-sustaining properties between a "Good Diet" and a "Bad Diet." Two groups of 20 half-grown rats of the same initial weight and growth-potential were fed on these two diets, there being the same number of males and females in each group. The "Good Diet" consisted of *atta chapattis*, milk, butter, green vegetables, sprouted gram, raw potato, carrot, tomato (as substitute for fruit), water and fresh meat once a week. The "Bad Diet" consisted of white bread, tea, sugar, margarine, a little milk to add to the tea, preserved meat, boiled vegetables, jam. Each group ate as much as they wanted. The weight curves show how the former flourished and how the latter did not. No. doubt the food preservatives (sulphurous acid, boracic acid and formaldehyde) present in some of the ingredients of the "Bad Diet" contributed to its ill-effects. These preservatives are present in jam, margarine and preserved meat.

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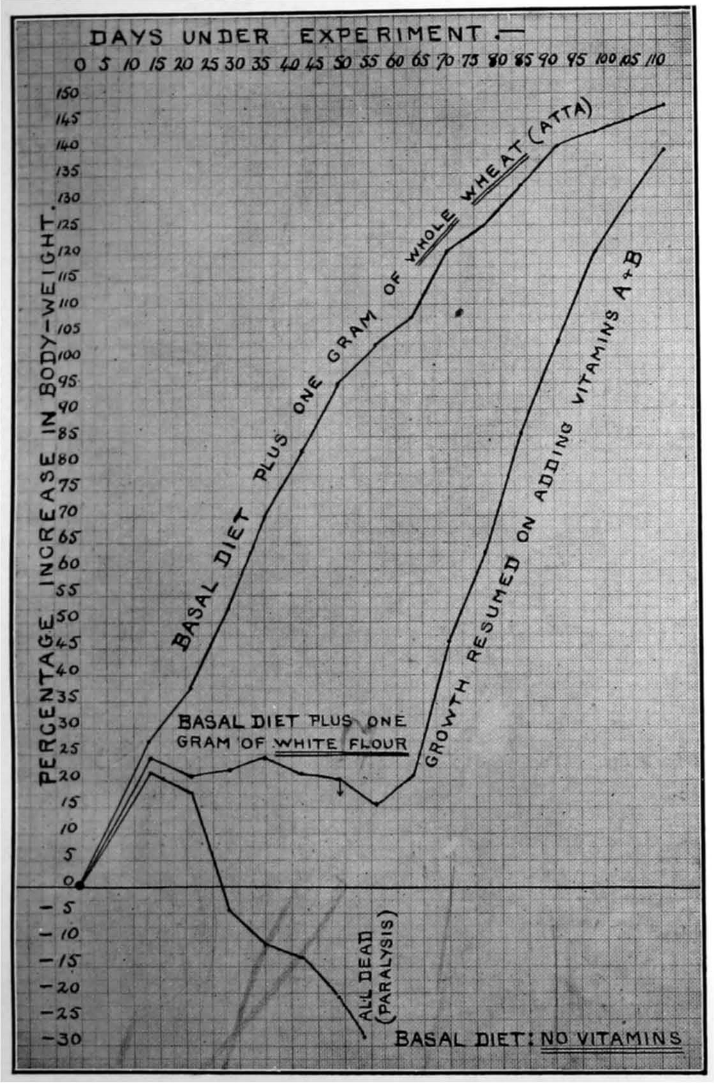
CHART H-2.



This shows the difference in nutritive value between whole wheat flour (*atta*) and American white flour. Three groups of young rats (six in each) of the same age, sex, growth, potential and initial weight, were fed on a basal diet complete in every respect but devoid of vitamins. One group (lowest curve) received this diet only and the animals failed to grow, lost weight and died of paralysis of the hind limbs. A second group (second curve) received this diet *plus* one gramme of American white flour as the sole additional source of vitamins. The animals in this group grew for the first 14 days of the experiment when growth ceased. They did not, however, become paralysed showing that white flour contains some anti-neuritic vitamin (hence beriberi is rare in Europe and America) but was very poor in a growth-promoting vitamin. A third group received the same basal diet *plus* one gramme of whole wheat flour (*atta*). At the point marked with the arrow on the second curve vitamin-A was added to the white flour diet. It did not improve the rate of growth. At the end of a fortnight vitamin-B was added.

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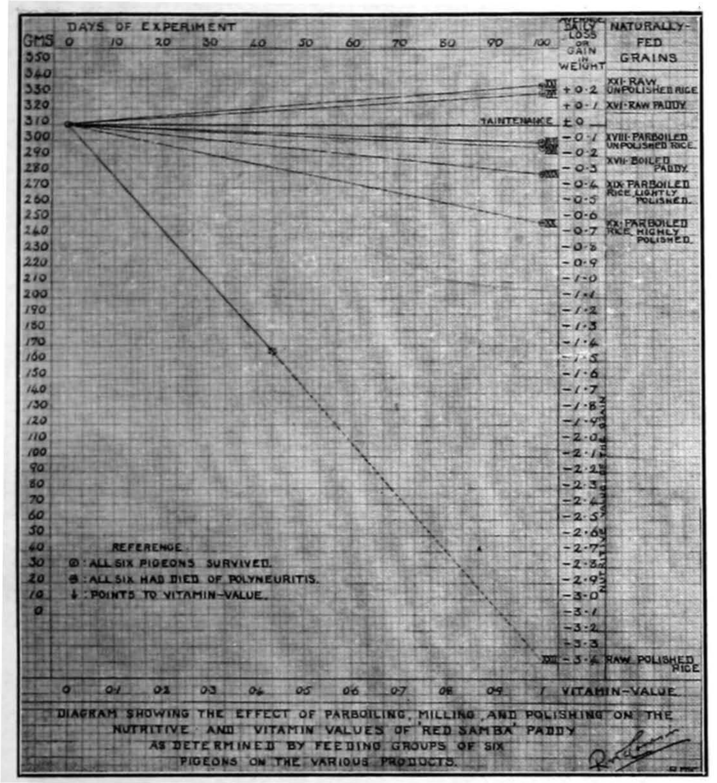
CHART J-1.



This shows the effect of parboiling, milling and polishing on rice This was tested by feeding groups of pigeons of the same initial aggregate body-weight (and of an average body-weight of 310 grammes) on the various products of a "red *Samba* paddy." The birds were fed exclusively on these products for a period of 100 days or until death. The *raw* unpolished rice is the best being slightly better than the raw paddy itself, due, no doubt, to the consumption of a certain amount of unnutritious husk with the latter. In both cases the diet keeps the birds above "maintenance level" (that is, they do not lose weight). Parboiling lowers the value of the rice to some extent (it preserves its vitamin-B but causes loss of vitamin-A): and milling and polishing of the parboiled rice further reduces its value due to loss of vitamin-B and other substances in the process. But even the highest degree of milling and polishing does not remove all the vitamin-B from parboiled rice while it removes almost all if the rice is not parboiled but is milled and polished in the raw state (bottom line in chart). The arrow on this line points to the "vitamin value" of the raw polished rice: 0·38. It ought to be 1·0 to ensure that the birds will be kept at maintenance level.

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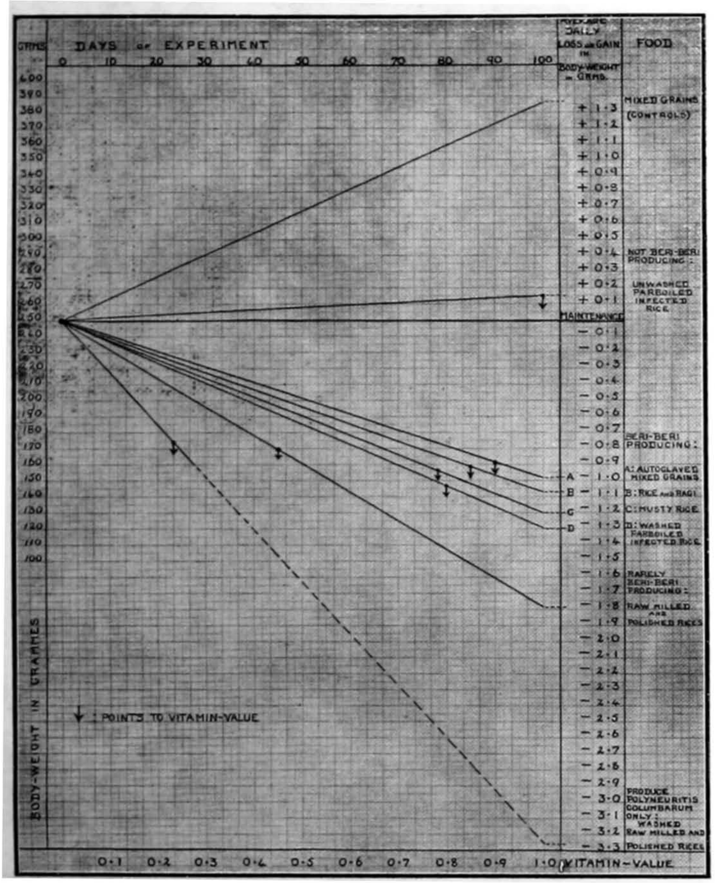
CHART J-2.



This shows the optimum food conditions for the production of the disease called beriberi. This disease is a condition of polyneuritis, with heart disease and dropsy. The basal factor in its causation is a diet—usually composed largely of polished rice—which contains "too little" vitamin-B for "maintenance" polished rice alone does not cause it (lowest line in chart) because the vitamin value of this rice is so low (0·24) that the animals cannot live at all. The disease only arises when the diets, such as those noted as A B C and D on the chart, have vitamin-B values which happen to lie between 0·75 and 0·9—the amount of vitamin-B required for "maintenance" being represented as 1·0. So that if a little *dal* be added to the diet of polished rice so as to raise the vitamin-B value of the diet to say 0·8 then beriberi will arise.

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CHART L.

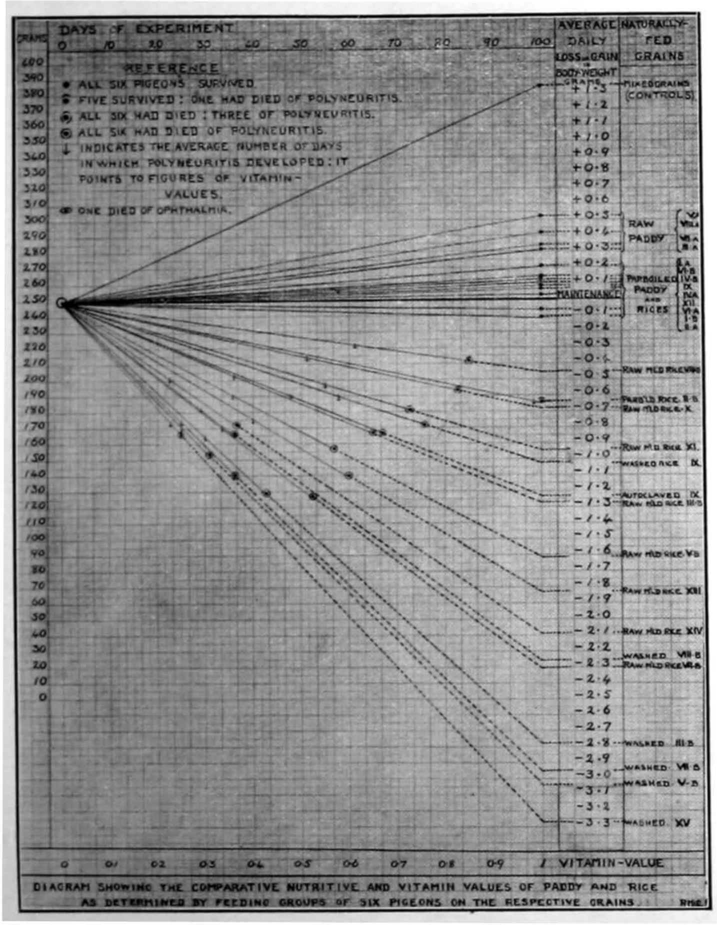

DIAGRAM SHOWING THE COMPARATIVE NUTRITIVE AND VITAMIN VALUES OF PADDY AND RICE AS DETERMINED BY FEEDING GROUPS OF SIX PIGEONS ON THE RESPECTIVE GRAINS.

This shows in the same way the comparative values of some 28 rices in common use in India. It will be noted how greatly they differ, due in the main to the degree of milling and polishing to which they have been subjected. The four bottom lines show the disastrous effects of much washing of raw milled and polished rice prior to its consumption. This is due to the fact that vitamin-B is soluble in water, so that any amount of this substance left in the rice may be washed out of it. Other important substances are also washed out in this way: notably phosphorus.

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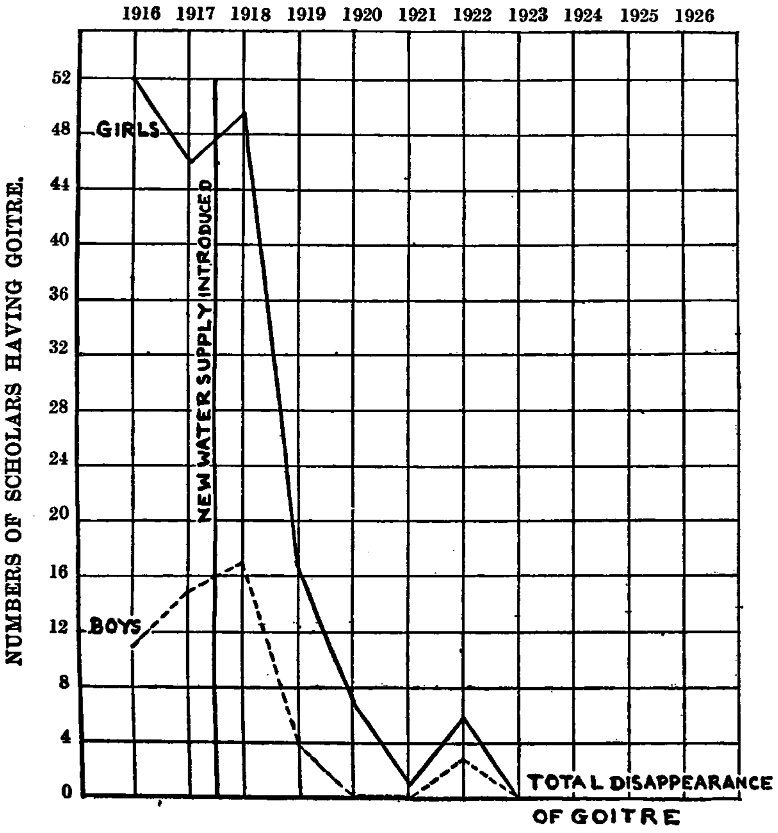
CHART N.

GOITRE AT THE ROYAL LAWRENCE MILITARY SCHOOL, SANAWAR.



This shows the eradication of goitre from a school (of 500 scholars) in the Punjab where goitre had prevailed since the establishment of the school after the Mutiny.

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CHART P.1.

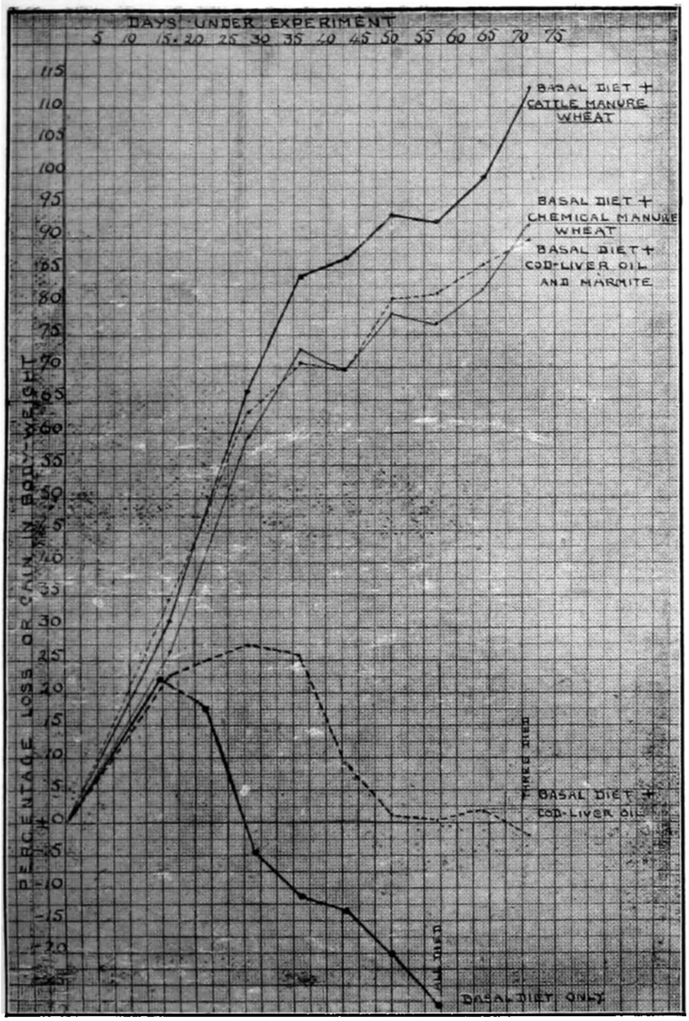

Chart showing the difference in nutritive value between "cattle manure wheat" and "chemical manure wheat."

This shows the effects of manure on the nutritive and vitamin value of wheat. Five groups of young rats were used: one received a basal diet only which was complete in every respect but had no vitamin-B and very little vitamin-A, no growth resulted (bottom curve); another had the same diet *plus* cod-liver oil to provide vitamin-A, again no growth resulted but death was delayed; a third had the same diet *plus* cod-liver oil (to supply vitamin-A) and marmite (to supply vitamin-B) (3rd curve) when good growth resulted; a fourth had the same diet *plus* one gramme of wheat, grown on soil manured with a *complete chemical manure*, (as the sole added source of vitamins) and good growth resulted equal to that given by cod-liver oil and marmite together (4th curve from bottom); a fifth had the same diet *plus* one gramme of wheat, grown on soil manured with *cattle manure*, (as the sole added source of vitamins), better growth resulted. The wheat grown on soil manured with cattle manure is thus approximately 17 per cent better than when grown on the same soil manured with chemical manure. The same result has recently been obtained with oats and *arhar* grown at Pusa.

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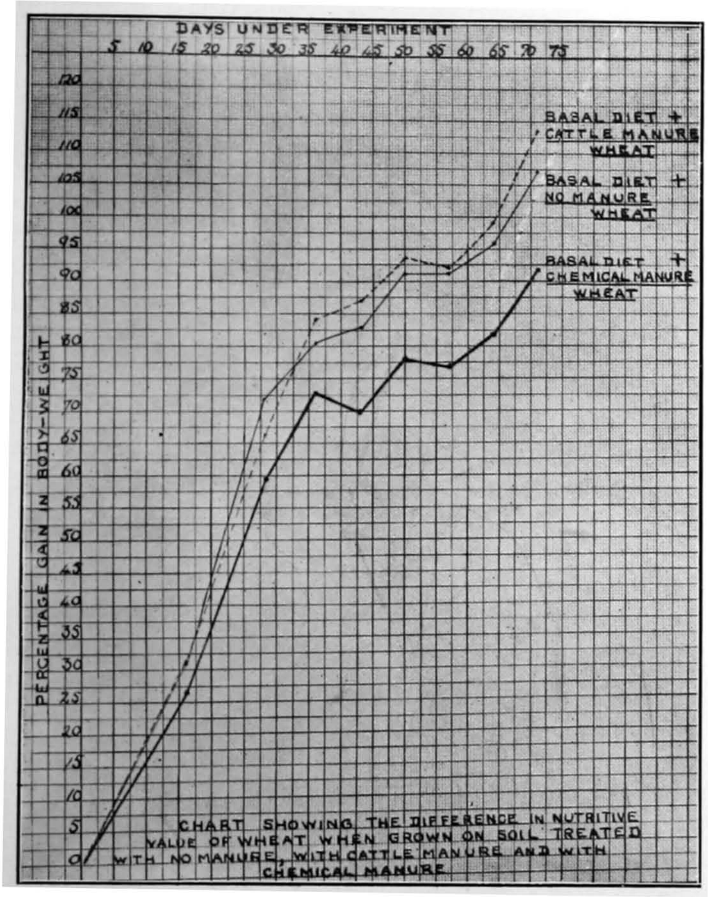
CHART P-2.



This shows the relative values of the same wheat when grown on the experimental plots at Coimbatore which received cattle manure, chemical manure and no manure at all. It is remarkable that though the yield in grain from the " no manure plot " is so much lower than either of the others, in nutritive and vitamin values it is higher than the chemically manured produce. The same result has recently been noted for oats and *arhar* grown at Pusa; so it is not a chance result.

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CHART Q.

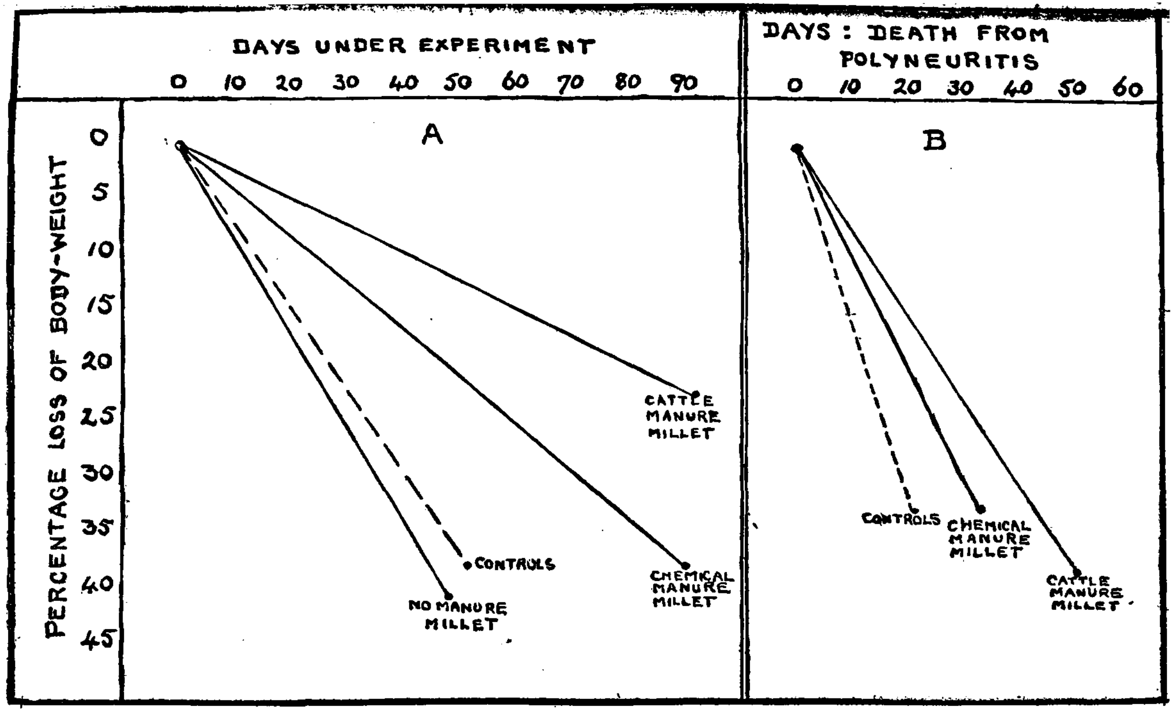
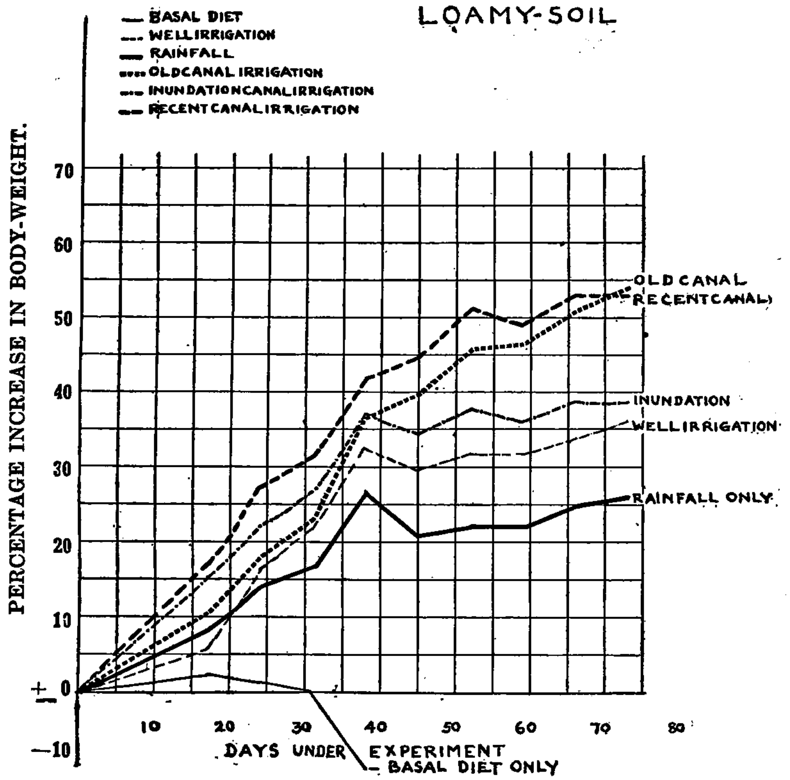


Chart A showing the percentage loss of weight in groups of pigeons, of the same initial aggregate weight, when fed on a basal diet of rice to which 'cattle manure millet' or 'chemical manure millet' or 'no manure millet' was added in the same amount (*vide* text). The controls received the basal diet only. Note that the addition of the 'no manure millet' actually increased the rate at which body-weight was lost and hastened the time of death as compared with controls which received no millet. 'Cattle millet' was markedly superior to either of the other millets in preventing the loss of weight caused by a diet of rice.

Chart B shows that 'cattle manure millet' was richer in vitamin B than 'chemical manure millet' since, when added in the same amount to a basal diet of raw, polished, washed and autoclaved rice, it delayed the onset of polyneuritis for a longer time. If the vitamin B value of 'cattle manure millet' be taken as 1 that of 'chemical manure millet' is approximately 0.66.

CHART R-1.



This shows the effect of different forms of irrigation, or water-supply, on the nutritive and vitamin values of wheat from the Punjab. The same wheat was used throughout but grown on loamy soil irrigated in different ways. The same technique was followed: groups of rats of the same age, weight, sex and growth potential, were used and fed on a basal diet which was complete in all respects except that it contained no vitamin-B and little vitamin-A. One group (the controls) received this basal diet only and did not grow; the other groups each received 1 gramme per animal daily of the whole wheat grown on loamy soil irrigated in different ways. The experimental work on this subject is not completed and definite conclusions cannot as yet be drawn, but this and the succeeding figures show that water-supply does make a difference to the nutritive value of the wheat, and that this difference depends to a considerable extent on the nature of the soil.

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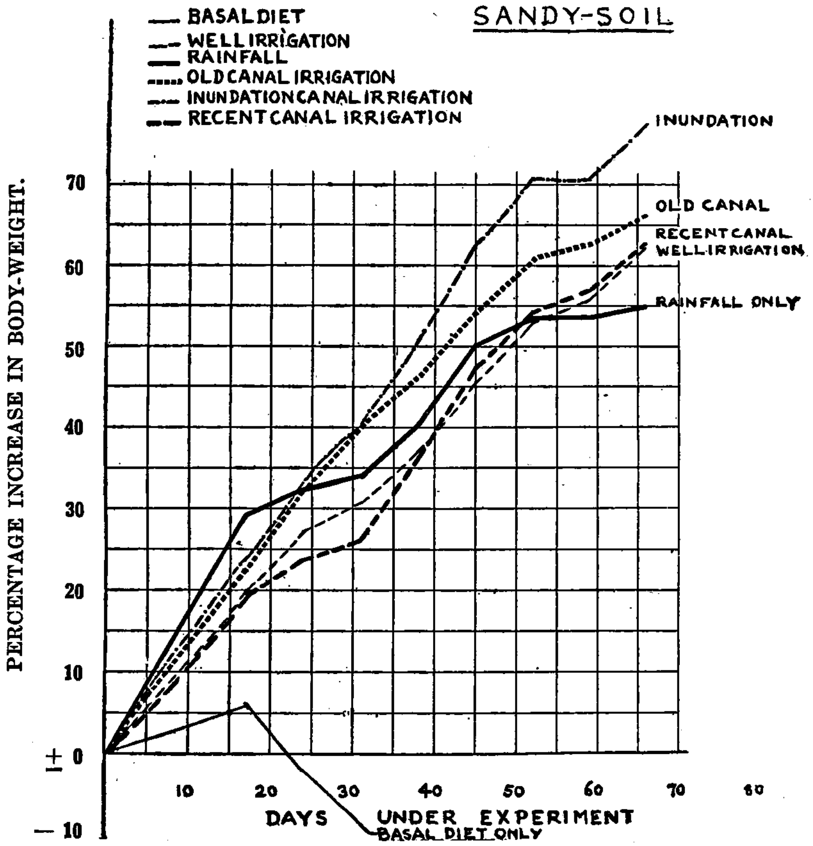
CHART R-2.



Same legend as for Chart R-1. In this case the wheat was grown on *sandy soil.*

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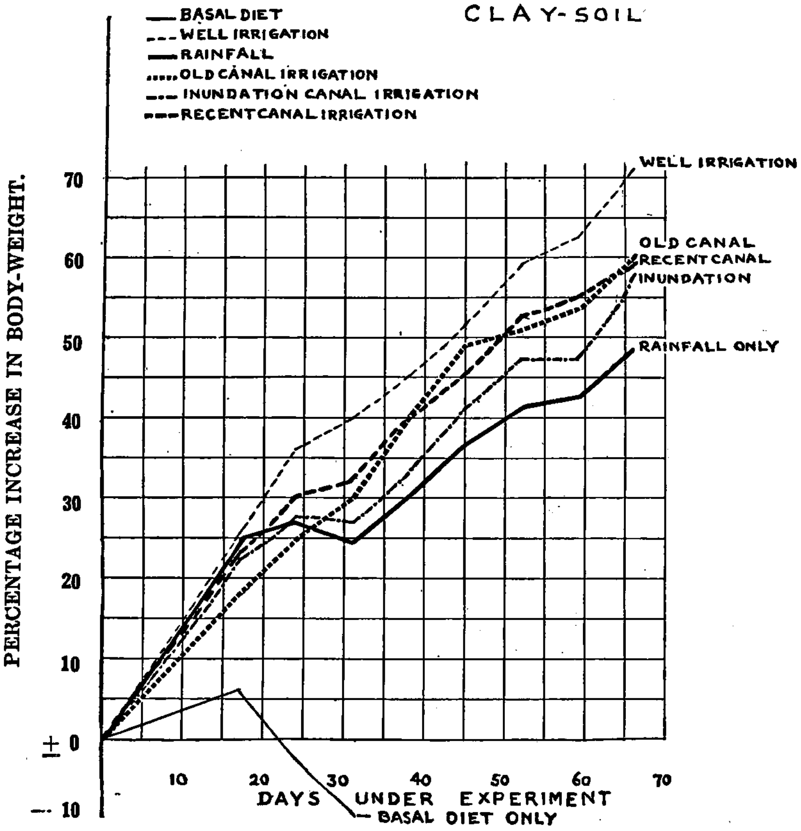
CHART R-3.



Same legend as for Chart R-1. In this case the wheat was grown on *clay soil.*

Lieut.-Col. R. McCarrison.

Tuesday, December 7th, 1926.

CALCUTTA.

PRESENT:

The MARQUESS OF LINLITHGOW, D.L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.	Mr. H. CALVERT, C.I.E., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.	Raja Sri KRISHNA CHANDRA GAJAPATI NARAYANA DEO of Parlakimedi.
Rai Bahadur Sir GANGA RAM, Kt., C.I.E., M.V.O.	Professor N. GANGULEE.
Sir JAMES MACKENNA, KT., C.I.E., I.C.S.	Dr. L. K. HYDER.
	Mr. B. S. KAMAT.

Mr. J. N. GUPTA, I.C.S.
Rai A. C. BANNERJI BAHADUR } (*Co-opted Members.*)

Mr. J. A. MADAN, I.C.S.
Mr. F. W. H. SMITH. } (*Joint Secretaries.*)

Dr. E. H. PASCOE, M.A., D.Sc., F.G.S., F.A.S.B., Director, Geological Survey of India.

Replies to the Questionnaire.

QUESTION 10.—(*f*) The few remarks I have to offer under this head form a corollary to Dr. Watson's paper published in a Supplement to the *Indian Trade Journal* (Vol. X, 27th August, 1908). The prevention of the waste of this valuable fertiliser evidently depends upon the availability of an equally cheap and efficient substitute. Of the three possible substitutes Dr. Watson showed that according to prices in 1908 kerosene was out of the question, and that wood could compete only in Madras, where it was a cheaper fuel, and in Bengal, where its price was much the same as that of cowdung cake. Presumably wood could have competed also in Upper Assam and the jungly parts of Burma. Dr. Watson showed that the selling price of cowdung cake was entirely fictitious and that its real value was at least 2½ times greater. Cowdung cake, in fact, ought to have been the dearest fuel—dearer even than kerosene oil (see *Indian Trade Journal*, Vol. XIII, p. 307; June 17th, 1909).

I have been unable to obtain in time figures regarding the present-day price of cowdung cake. The average price of Bengal coal was about Rs. 6-12-0 in 1908 and about Rs. 7-9-0 in 1925. I shall assume that the present ratio between the prices of cowdung cake and coal differs to no large extent from the ratio in 1908. Dr. Watson's figure showed that in most parts of India coal was a closer and more promising competitor, and it is on this that I would submit a few remarks.

If cowdung cake were estimated at its real value, we may assume that none of it would be used for fuel purposes, for coal, coke, wood and oil would be considerably cheaper. The more the value of cowdung cake could be brought home to the agriculturist, the higher would rise its price. A point would soon be reached at which other fuels would supplant it, and the first of these in most of the Provinces would be coal, or, more probably, its artificial product, coke.

There are in India large quantities of second grade coal which finds such a limited market that in many cases it does not pay to exploit it. In a poor country like India it is natural to regard it as the ultimate solution of the domestic fuel problem. Very little is known about the quantity and quality of the coal, but the whole subject is at present under investigation by the Geological Survey of India. Dr. Fox, who is superintending the enquiry, has been asked to include in his programme the question of the domestic consumption of all grades of coal and of the soft coke produced therefrom, the coking properties of the various seams investigated, and, if possible, to some extent the improvement and cheapening of transport. The re-survey of the coal fields will take another two or three years to complete. Any suggestions now made are made in anticipation of the results and are necessarily somewhat indefinite.

The reason why coal or coke is not competing to a sufficient extent with cowdung cake as a domestic fuel amongst the masses of the population is for the most part one of price. Much of the second grade coal of India is lying unworked, because the market price obtainable for it is too low to allow of its being raised remuneratively. If the price of cowdung cake were raised as a result of propaganda work to a sufficient figure, it would bring the second grade coal into the market as a competitor. A large proportion of this coal—Dr. Fox believes the greater part of it—will yield a soft coke eminently suitable for the domestic *chulha*. The coke is a little more expensive, heat for heat, than the coal, as Dr. Watson's figures show, and the price of cowdung cake would have to be increased accordingly before the coke could compete.

With a suitable *chulha* uncoked second grade coal can be used for cooking purposes. Very little coal is used, as such, in India for cooking purposes, the reason being that the smoke of it contaminates and gives an unpleasant taste to the food. Smoke is not objected to so much in the air of the room. The use of coal for cooking purposes is to a large extent limited to employees on the coalfields, and the reason why it is used there is that it is given them free. Even then the coal is kindled long before the operation of cooking takes place, and is reduced to a glowing coke before the food is placed over it. The gaseous part of the coal is thus wasted. Sometimes employees of a Coal Company club together and coke the coal allowed, on a small scale and, needless to say, in a wasteful manner, and use the coke so produced in their *chulhas*.

The trouble with a new type of stove is the difficulty of persuading Indian villagers to buy it. Not only is there the usual intense conservatism—and perhaps religious partiality for a fuel which is the product of a sacred animal—but an intense dislike to spend even a few annas on a new article of, to them, problematical efficiency, requiring intelligence, thought and experience. It might pay the coal companies to present coal-burning *chulhas* or to sell them below cost price to families buying their coal. It might be worth while for Government to offer a prize for the improvement of a cheap *chulha* which would burn coal and cook rice, *chapattis* or curry without smoking them. It should not be a difficult problem. Some sort of chimney seems the most essential thing, and other possible lines of enquiry (on which Dr. Fox proposes to make a few simple experiments) are the briquetting of coal slack with some inert substance to reduce the rate of combustion and the use of a bellows to reduce the smoke to a minimum.

The difficulties in the case of coal burned as such do not appear insuperable, but the substitution of coke seems to me a much more promising remedy. The price of soft coke is usually about 50 per cent. greater, sometimes a little more, than that of coal, but, as Dr. Watson shows, heat for heat, the difference in price is small. Much of the second grade coal now being worked is worked because it is necessary to do so to get at the better-grade coal. In other cases the high grade coal of a seam is taken out, and the rest—often forming the bulk of the seam—is left behind in the ground; whether it will ever be taken out is a matter of price.

Dr. E. H. Pascoe.

Were an adequate market and a suitable price obtainable, there is little doubt that large quantities of soft coke—a fuel acceptable in nearly every way to the Indian villager could be placed upon the market and distributed by railways and ultimately by bullock carts assisted perhaps in some cases by steam road lorries or motor lorries. Government could assist by improving the roads where necessary. There are in the Raniganj, Jharia and Bokaro coalfields thousands of millions of tons of second grade coal, much of which would yield a soft coke. The danger to the scheme lies in the absorption of profits by middlemen, and a maximum selling price would probably have to be fixed either by the coal companies in combination or by Government; in the latter case some sort of licensing system would perhaps be necessary.

The ideal medium for the distribution of coal would be canals. Unfortunately, navigation canals, on the whole, have met with indifferent success financially in India. Nevertheless, I think the question of tapping some of the large Damodar Valley Coalfields by canal is worth careful investigation. Barges thus brought down to the Ganges could be towed by tugs to the populous tracts of the Ganges Valley.

The whole question seems to depend upon the education of agriculturists to the value of cowdung cake and thus raising it nearer to its actual value. If this could be done, the substitution of coke or perhaps in some cases coal would, I think, follow as a matter of course. The question of bringing home to the agriculturists the value of cowdung cake is outside my scope. Really informative propaganda, by which I mean propanganda which not only tells the enquirer what he ought to do, but also why he ought to do it, is perhaps the most important line of action.

It might be worth while for Government to appoint a small committee to consider the whole matter, the committee to include an agriculturist, a geologist and an engineer, with powers to co-opt.

Dr. E. H. Pascoe.

Oral Evidence.

A.919. *The Chairman:* Dr. Pascoe, you are in charge of the Geological Survey of India?—Yes.

A.920. You have provided the Commission with answers to certain questions in our Questionnaire and you are also, I think, responsible for the production of a memorandum on India's resources in mineral fertilisers, which memorandum was forwarded to us by the Central Government sometime ago. Have you any remarks of a general character which you wish to address to the Commission at this stage?—No. All I have to say I have put into my note in answer to the Questionnaire.

A.921. Your memoradum in answer to our Questionnaire is confined almost entirely to suggestions as to how Government or other agencies may assist in solving the problem of persuading the cultivator not to burn cowdung?—Yes.

A.922. You have provided us with certain facts and given references, the effect of which is to show that the actual calorific value of cowdung in relation to its value cannot be taken as sufficient reason for the practice of burning cowdung in place of coal?—Dr. Watson has proved that in a paper which has appeared in the *Indian Trade Journal.*

A.923. But you point out that apart from custom there is in this connection the matter of convenience in that the fuel is not burned in a fire-place with a chimney, but it is very often burned in the open house in a *chulha*?—Yes.

A.924. Dried cowdung gives a slow smouldering fire which, I suppose, is ideal for certain practices of cooking; is it not?—I suppose so.

A.925. Do you not think the difficulty of getting a fuel other than cowdung which gives a steady heat for long periods without any flame or smoke is one of the principal reasons why cultivators insist upon using cowdung?—Yes, that is the principal difficulty. When villagers use coal they let it burn outside until they have a glowing smokeless fire, which they then take into the house and use for cooking purposes.

A.926. And it goes on glowing for a very long time?—Yes, until the coke is exhausted.

A.927. Without any chimney?—I believe so.

A.928. Do you suggest that there are any practical steps in the way of promoting the wider distribution and cheaper production of coal that Government might take which might be expected to lead to a substantial reduction in the amount of cowdung burnt?—I cannot suggest any action that Government could take. It seems to me the main point is to bring home to the cultivator the value of cowdung, and by raising its price enable coal or coke to compete with it.

A.929. I want to turn for a moment to the note on fertilisers to which I made a reference. You give there full information about all that has been done in the way of a survey of those various products and natural deposits. Do you think that that survey is complete, or do you think that other deposits ought to be discovered or made available?—Do you refer to any particular deposits?

A.930. No. Let us take them one by one. What about rock phosphates?—I do not think there is any likelihood of any extensive deposits being found. I have a staff of only 30 to deal with the whole of India, and one cannot cover very much ground during the year with such a small staff. But there is no likelihood of large deposits being found.

A.931. I take it nitrate of potash deposists in old towns and villages may exist almost to an unlimited extent?—The extent to which they exist is unknown.

A.932. What about limestone? Is that a substance which exists in India?—That is a universal product that could be obtained anywhere in India. There is no lack of limestone in the country except in particular districts.

A.933. And gypsum?—Gypsum is fairly universal; there is not very much in Madras and the Central Provinces, but in the Punjab, and Burma there are large quantities of it.

A.934. What is your method? Are you carrying out a further survey in detail throughout the country?—Yes; we have parties working in each Province and we also undertake enquiries regarding any special problem that crops up, the testing of dam-sites for instance and questions of that nature.

A.935. You are gradually building up a more detailed and complete survey than that which exists at the moment?—Yes. All our information is published as soon as available.

A.936. What about the Indian States?—We have in the past done a good deal of work in the Indian States, but according to a recent order Indian States are now asked to pay for such surveys, so that they sometimes refuse to have them.

A.937. Is it your view that there may be important deposits of mineral fertiliser in Indian States which have not yet been discovered?—No.

A.938. How far do your responsibilities go? Merely the discovery and recording of those matters, I take it?—Yes.

A.939. Are you concerned at all about advising anybody about the technical methods of extraction?—We help as much as possible, but we take responsibility for nothing of that sort.

A.940. Nor, I take it, do you interest yourself in the geographical position of those deposits in relation to areas where soil deficiencies exist in the neighbourhood?—No; we have not taken up that side of the work.

A.941. That is important in relation to the heavy charge for transport?—Yes.

A.942. *Sir Ganga Ram:* Does the official note* contain an account of the deposits in the Indian States?—It has reference to British India mainly; if we had any information regarding Indian States it would be mentioned there.

A.943. *Professor Gangulee:* With regard to phosphatic manure for this country, you are definitely of opinion that we cannot look to rock phosphates for the supply of that manure?—Yes.

A.944. What about Trichy nodules?—They have been examined. We have no information as to quantity because it is difficult to estimate; they occur in lenticular patches and one cannot very well measure them.

A.945. So, we will have to depend on bonemeal for phosphatic supply?—Yes.

A.946. You are definitely of the opinion that that is the only source that India can take to?—We can supplement that with a certain amount of phosphates.

A.947. Not to any great extent?—No.

A.948. As regards second grade coal, have any experiments been done with regard to its calorific value?—Yes; there are figures regarding different qualities of coal.

A.949. What about quantity?—An estimate was made by Sir Henry Hayden 4 or 5 years ago, and his figure was 78,000 million tons of coal in the country. I suppose out of that about 75,000 million tons would be second class coal. That estimate was based on mining only to a depth of between 500 and 1,000 feet; if you went to 2,000 feet you might say there are 150,000 million tons.

A.950. Do you consider that that presents a hopeful field for the expansion of fuel supply?—The amount of coal available may, for practical purposes, be regarded as limitless.

A.951. *Mr. Calvert:* Do you think there is a large field for the use of coal dust and charcoal dust for village fuel?—Do you mean first class coal or second class coal?

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* Not reprinted: Note on India's Resources in Mineral Fertilisers in memoranda prepared by the Government of India for the Commission.

A.952. Dust coal and dust charcoal, which is wasted?—With dust coal you will still get the smoke. With wood charcoal you do away with the smoke difficulty.

A.953. From coal you get smoke?—Yes; with coal you will get the smoke unless it is burnt to coke first.

A.954. But charcoal is free from that?—You mean wood charcoal?

A.955. Yes?—Yes.

A.956. Have you any experience of charcoal briquetting?—No; it does not come within my sphere.

A.957. *Mr. Kamat:* At present a lot of minerals is exported from this country in a raw state. Have you considered the advisability of turning them into finished products in this country, so as to give occupation to the people?—Yes, Government are always willing to take any measure to encourage the manufacture of finished articles from the raw products.

A.958. Is literature available in your department if private enterprise comes forward to do it?—Yes.

A.959. *Rai Bahadur Bannerji:* You have suggested in this note of yours that if the value of the use of cowdung as a manure is taught to the people and they are given a cheaper fuel, perhaps a time will come when cowdung will be used mostly as manure. And you are also of opinion that enquiry should be made into the possibility of briquetting of coal slack with some inert substance to reduce the rate of combustion and the use of bellows to reduce the smoke to a minimum. Any experiment on briquetting coal dust should be conducted on second class coal. Is any experiment being made in our country in that line?—None that I know of.

A.960. Have experiments been made in England and other countries on briquetting of second class coal dust?—A mixture of clay and second class coal has, I believe, been used with a certain amount of success.

A.960*a*. And it had a certain amount of commercial success?—That I cannot say, but it does minimise the smoke.

A.961. That experiment is not being made now, and it will be sometime before it is taken up by anybody here. The people of India do not commonly care for the smoke, they even use steam coal. But generally they burn soft coke which has less smoke after it is rendered red hot (*pora* coal as it is called in Bengali). If the coal-owners manufacture a larger quantity of this soft coke, do you not think it will be in a position to replace cowdung altogether?—Yes; that is my suggestion.

A.962. How would you induce a large sale of this soft coke among the people in the interior of the country?—Raise the price of cowdung cake, and if possible lower the price of the coke.

A.963. Lowering of the price of coke has been done in two ways, first, by the owners reducing the price and, secondly, the carrying railways reducing their freight. Would you advocate a reduction of railway freight on soft coke by Government interference?—It is a question which I hardly feel competent to answer; it is not a geological question.

A.964. The Indian Mining Federation, the members of which deal with second class coal generally and most of whom have collieries in the Jharia fields which is coking coal, have approached Government with the request that the railway freight for soft coke should be reduced by 50 per cent, so that they may offer soft coke for fuel purposes. Do you advocate it?—It would certainly have the effect of reducing the price of soft coke, but I cannot say that I am keen on Government interference in things of that kind, from a general point of view.

A.965. What the Government will do is neither my lookout nor yours. If soft coke will be within the easy reach of the common masses, they may be induced to give up burning cowdung for fuel?—If we reduce it by 50 per cent I should say yes.

A.966. *Sir Ganga Ram:* Is there a central laboratory to make experiments on manures to be made out of these natural deposits?—I have a laboratory in my office in which we carry out simple experiments of that sort, and the Government Test House at Alipore carries out experiments on coal.

A.967. Experiments on natural deposits which can be turned into manure? Supposing I send you a natural deposit, would your laboratory give any results? —We could analyse it for you and tell you what it consists of.

A.968. Could you say by what process it can be made into manure?—Yes.

A.969. *Sir Thomas Middleton:* Has the Geological Survey carried out any special surveys of Government experimental farms?—No.

A.970. Has the Survey published any papers on the subject of the relation of soil to rock formation?—The only paper of that sort which I recollect is the paper by Center on *reh.* It is a very old paper.

A.971. At the present time, are your survey parties exclusively engaged in the mineral areas?—No, we have survey parties doing purely scientific work.

A.972. On what scale do they map?—On the largest scale for which we can get topographical maps.

A.973. 6 inch maps?—6 inch maps are not available in this country.

A.974. What do you get to work upon?—One inch maps.

A.975. *Sir Ganga Ram:* Are those maps for sale?—They are for sale by the Survey of India.

A.976. *Sir Thomas Middleton:* Are the Geological maps published?—They are published in our publications with the reports.

A.977. They are not issued separately for sale?—No.

A.978. Have you any general geological maps of Provinces on a scale of about 25 miles to the inch?—We have a map on the scale of 32 miles to the inch, which we are now revising.

A.979. Published for All-India?—It has never been printed yet; it is all coloured by hand, but the new edition we are going to have printed off in colour.

A.980. What is available to the public at the present time?—Various maps which appear in connection with memoirs.

A.981. *Dr. Hyder:* Your paper is based on the paper contributed by Dr. Watson?—Yes.

A.982. What would be the manurial value of a maund of cowdung? At present, if cowdung is used as manure, what would be its value in rupees?—I understood it would be about 11¼ annas a maund.

A.983. That was in the year 1908?—Yes.

A.984. You do not possess the figures for the present year?—I have been trying to get them.

A.985 According to Dr. Watson's paper, its manurial value would be 11 annas per maund, and when it is used as fuel its value is 4 annas?—As fuel its value is 4¼ annas.

A.986. So, this country loses, on every maund of cowdung burnt as fuel, about 7 annas?—Yes.

A.987. That is the net loss to agriculture?—Yes.

(The witness withdrew.)

The Commission then adjourned till 9-30 A.M. *on Wednesday, the 8th December, 1926. For proceedings of meetings of 8th December 1926, and 5th to 7th January 1927, see Volume IV, and for 13th to 19th December 1926, see Volume V.*

Monday, January 10th, 1927.

PUSA.

PRESENT :

The MARQUESS OF LINLITHGOW, D.L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.
Rai Bahadur Sir GANGA RAM, Kt., C.I.E., M.V.O.
Sir JAMES MACKENNA, Kt., C.I.E., I.C.S.

Mr. H. CALVERT, C.I.E., I.C.S.
Professor N. GANGULEE.
Dr. L. K. HYDER.
Mr. B. S. KAMAT.

Mr. J. A. MADAN, I.C.S.
Mr. F. W. H. SMITH.
} (*Joint Secretaries.*)

Mr. G. S. HENDERSON, N.D.A., N.D.D., Imperial Agriculturist, Pusa.

Replies to the Questionnaire.

QUESTION 1.—RESEARCH.—(*a*) (*i*) *and* (*ii*) I have dealt with this at large under Question 4, Administration. Veterinary work should be an essential part of any development in Agriculture.

(*b*) *and* (*c*) The Agricultural Departments have so far merely touched the fringe of the possible problems for investigation and research. It is my opinion that the first step should be that of setting the administration in order and an orderly survey made of the means available for an organised attack on the present terrible state of agriculture and livestock in India.

Some crops have had more attention than others, but there are crops such as potatoes of great importance which have had little attention. The whole question of grading of export crops needs thorough investigation, probably drastic legislative action will be required to raise the standard of Indian agricultural exports. This has been found necessary in other countries. An example may be quoted of Canada regarding wheat and Australia regarding dairy produce. The whole field of agriculture and livestock in India is in the greatest need of investigation and research. It hardly seems possible to name any lines of work which would not directly or indirectly give most valuable results, if properly prosecuted. The great dangers of course are misdirected effort, waste and extravagance, and in my opinion the real duty of the Central Government is to direct effort and public opinion along proper lines. Money is always available for the prosecution of research either from the trade or from the public interested. It would be a thousand pities to see a number of different agencies all working independently and not using their energies in the best possible manner. India is certainly coming within sight of such a state owing to the number of independent bureaux and committees which are being established simply because there is no central body strong enough to take them all into its fold.

QUESTION 4.—ADMINISTRATION. In my opinion the stage has now been reached in the history of the Agricultural Departments of India at which the greatest necessity is a thorough revision and reorganisation of the existing administrative system.

The most outstanding feature of the growth of these departments in India is that their expansion has been extremely unequal. The original plan was that a staff of experts with a central teaching institution should be provided for each of the Provinces in India. In some cases the Provinces began with some sort of agricultural organisation and so got a good start. An examination of the present budget of the various Provinces reveals this startling difference and this difference appears to be steadily increasing year by year. On one hand we have the Punjab spending Rs. 14,00,886 in 1924-25 and on the other side Assam spending Rs. 2,72,768 and Bihar and Orissa spending Rs. 4,81,629. This means that different parts of India are being catered for in very different degrees. Other factors which complicate the situation are :—first, the Provinces have purely political boundaries; in some cases they are less homogeneous than is the continent of Europe; also homogeneous tracts spread through two or three Provinces. The second important factor is that there is a large area under Indian States which in many cases are practically independent.

If the present state of affairs continues, some of the Provinces will have a very large organisation and will completely overshadow not only the other Provinces but also the agricultural machinery of the Central Government.

The original idea of the Central Agricultural Department at Pusa was a body of scientific experts divided into the following sections:—

1. Chemical section,
2. Agricultural section,
3. Mycological section,
4. Bacteriological section,
5. Botanical section,
6. Entomological section.

The Heads of these Sections were presumed to be experts of such standing that they carried weight in their branch of agricultural science throughout India. They were situated at Pusa as a convenient centre or more probably from motives of economy as the Pusa Estate was lying vacant. The Director of Pusa was the co-ordinating Head and the department as a whole was represented by the Inspector General of Agriculture who kept in touch with the Central Government and by means of extensive touring, was acquainted with conditions in all Provinces. His advice was in request by the young departments. This post was then abolished and the Director of Pusa and Agricultural Adviser to the Government of India were vested in the one incumbent.

In my opinion the time has now arrived for a thorough consideration of this situation. It seems to me that the Department of Agriculture under the Central Government has been too closely associated with Pusa. The name Pusa and the Central Agricultural Department are almost synonymous. The only exception follows on the creation of the Section of Dairying situated at Bangalore. Hand in hand with the extension which has taken place in some of the Provinces, there should have been expansion and extension not so much of Pusa, as of the Sections. Some of the Sections should have expanded and established centres in other parts of India if anything like the original proportion was to have been maintained.

The present situation is further complicated by the establishment of various central committees and bureaux dealing with special crops, such as the Central Cotton Committee and the Sugar Bureau. There is a branch of the Central Cotton Committee concerned with cotton work situated at Indore. The Head of this establishment is called the Agricultural Adviser to the Indian States and Director Plant Breeding Institute, Indore, and is under a practically independent committee.

The political aspect under the new conditions following the Reform Scheme is all important. Where the Directors of Agriculture are in touch with current political affairs, there is a much greater likelihood of getting the requisite financial support and machinery for expansion. In some Provinces the Director is a member of the Legislative Council, in other cases, he deals with the Minister concerned, chiefly through permanent secretaries and under-secretaries. Difficulties may be caused by the situation of headquarters and other factors. These factors have a large bearing on the success of a department. In the Central Government the Head of the Agricultural Department has to be frequently present with the Government in Simla and Delhi while his main headquarters is at Pusa and he has to do heavy touring to keep in touch with all the Provinces in India.

We can now consider what the situation would be in the event of the large extensions which are foreshadowed in some of the Provinces being given effect to. It would be possible to carry on as at present with Pusa as the headquarters of a body of scientific experts comprising the advisory staff attached to the Agricultural Adviser to the Government of India. In this case, the general tendency undoubtedly would be for Pusa to turn into a very centralised body having less and less connection with current agricultural affairs in India, as the development of the Provincial Agricultural Department increased.

The retention of the present Board of Agriculture or even an enlarged body in its place would do little to help matters.

The chief criticism of this state of affairs would be that practically all initiative would pass from the Government of India in agricultural affairs. It would be very difficult to see how problems which affect two or more Provinces could be properly taken in hand. Questions affecting trade, export crops and large Indian States would probably remain in abeyance. The Government of India is responsible for questions of a national character in India and it does not seem these can be suitably solved by handing over the direction of affairs to be dealt with piecemeal by provincial departments. We have heard the cry from a Provincial Director of Agriculture, " We want no interference from Pusa "; by this is meant the Central Department of Agriculture, but it is hardly likely that the Government of India would ever interfere even in the remotest way with any purely domestic question in a Province.

The simplest and most logical method of expansion for the Central Agricultural Department might have begun about the time when owing to the growth of the provincial departments, it was found expedient to replace the Covenanted Civil Service Directors by members of the Agricultural Service. At this time the Heads of the sections at Pusa should have been raised to at least the grade of Directors of Agriculture and made responsible for the activities of their sections throughout India. If this had been done, a thoroughly sound nucleus would have been available for eventually building up a business-like department on sound lines. No action of this nature was taken with the inevitable result that work at Pusa tends to become more and more divorced from that being done in the Provinces. Senior members of the Agricultural Service fight shy of any of the Pusa posts largely because it is realised that coming to Pusa means their chances of promotion in their own Provinces are very greatly lessened and also because advantages of proportionate pension are not given to members of the Central Agricultural Department though they are members of an All-India Service.

One effect of the Reform Scheme is a considerable tightening up of financial control. Audit inspections are much more rigid, and in a subject like experimental agriculture, the ordinary audit principles suited for the large routine establishments of the Government of India are totally inapplicable. The result is a considerable amount of interference, loss of time and diversion of staff from proper work to explain elementary facts to the audit officers. As an example of this, some of the members of the Agricultural Section had to be diverted from their research work to try to explain to the audit staff such questions as the following :—

1. Why self-binders and reaping machines lie idle most part of the year?

2. Why some cows calved every year while some only calve once in two years?

3. Why is it not possible to purchase stores in the cheaper season to avoid loss due to a rise in the market? These are a few examples from the report of about 80 pages of objections.

As the financial hold increases, the general tendency will be to hold the Director of Pusa personally responsible for all the work and gradually decrease the limited powers and initiative orginally vested in Heads of Sections. In my opinion it is this fact that lies at the bottom of much of the criticism raised against Pusa.

The Government of India must have a strong central executive body to co-ordinate and to advise on all questions of agricultural nature in India. They must have the machinery for keeping in intimate touch with provincial agricultural affairs. Some Provinces seem to think that any central authority should merely be of an advisory nature, but such is hardly possible. There are innumerable difficulties. In the stress of political conflict, the authority of such a body would probably be null and void.

Such central executive authority has been found necessary in all parts of the world and a very good model for India to copy would be the Central Department in the United States of America. The Head of the department must be a member or have a representative in the Assembly. He should rank as a Secretary to Government. As it is a physical impossibility for any one man to tour India sufficiently intensely to be thoroughly informed about local conditions, three or four experienced agricultural officers are needed to keep the central authority in touch with the provincial authorities. It would be necessary to take an officer for each division with considerable experience in that class of agriculture, *e.g.*, a man who has done his ten to fifteen years in the Madras Agricultural Department would command weight as a representative for South India and so on. The machinery would be built up as funds and facilities are available for the establishment of branches or divisions, one for each staple crop, one for each of the present Sections of Pusa if needed, one for agricultural machinery implements, one for irrigation, one for livestock and dairying, one for trade questions dealing with the grading and quality of India's export crops; manures would also have to receive attention. Other divisions required would be publicity, meteorology, education, statistics and publications, and liaison machinery for co-ordinating with the Irrigation Department, Forest Department and the Veterinary Department, etc.

A mass of details would have to be carefully considered, but unless some plan on the above lines can be evolved, it is difficult to see how the future Government agricultural work and its allied branches can avoid falling into a chaotic state. There is no reason why in the event of some such organisation being established, the relation between it and the Provincial Agricultural Departments should not be perfectly harmonious. One of the disadvantages of provincial rule is the water-tight compartments into which various tracts of similar agricultural areas are divided. The Central Department might avoid overlapping and would obtain much quicker development by arranging working agreements in the case where neighbouring Provinces have homogeneous tracts or where they are working on one problem under similar conditions. To take two concrete instances, Sind and the South Punjab, secondly Eastern United Provinces, North Bihar, North-West Bengal; these are cases in point of homogeneous tracts running through several Provinces which could very easily be grouped together.

If the above scheme is contrary to the Government of India Act and the Devolution Rules, I still think that before any form of body composed of Directors of Agriculture is formed, the Central framework must be considerably strengthened and the Head of the department put on a higher plane than is the case at present.

(c) (*ii*) *Railways and Steamers.*—The present situation in India with regard to freight haulage especially small parcels less than a truck load can only be described as very bad. In long distance hauls especially where there is a break of gauge, the situation is extremely bad. There is invariable delay.

(*iii*) *Roads*.—In some districts such as Sind, roads are practically non-existent and camels are the only practical means of transport. Much could be done if funds were available.

(*iv*) *Meteorological Department*.—I am of the opinion that closer co-operation with this department and the Agricultural Department is required. It is more a provincial matter however than a central one.

QUESTION 8.—IRRIGATION.—The extension of irrigation by surface water from rivers, etc., and the utilisation of the underground water are both of vital importance.

Sind is an example of a country in which cultivation is practically impossible without irrigation. In other parts of India wells are of more importance. They generally extend the season of cultivation or help out a deficient monsoon.

The importance of well irrigation can be seen by the fact that some 16,000,000 acres are commanded by wells. The difficulties in the way of expansion both of wells as well as of large canal projects are chiefly those connected with finance. The questions asked under this head refer to districts and any general answers would be of no avail.

QUESTION 9.—SOILS.—(*a*) (*i*) Under this head I would instance a method on new lines which has been adopted for improving waste lands at Pusa which are subject to heavy flooding in the monsoon. There are considerable areas of this class of land in North-East India where large rivers coming from the hills are headed up by the Ganges in flood and considerable areas are periodically flooded. In the case of Pusa, the land was of a coarse sandy nature and grew rough grass and jungle practically unsuited for any economic purpose. After flooding, the land dried very rapidly and cropping was too precarious to render it practical. Some four years back about 130 acres of this land was gradually levelled as farm bullocks were available and irrigation pumps were provided at convenient spots along the river. When the land was fit to plough after the floods had abated, *berseem* or Egyptian clover was sown. This gave several grazings until the hot weather started. Thereupon maize was sown which was gradually cut for fodder until the rise of the river prevented further work. No attempt was made to keep the land from being flooded. It has been found that this system works very well combined with a dairy herd of cattle. Green fodder is provided at a critical part of the year.

(*ii*) *Reclamation of alkali land*.—I had experience in this class of work before coming to India in a large reclamation work at Lake Aboukir in North Egypt. I did some work on these lines in Sind at Dowlatpur and at Sukkur. I am a member of the standing committee of the Harappa Bara Reclamation Farm in the Punjab. I submit a copy of the bulletin* on this subject.

(*b*) (*i*) Where leguminous crops have been cultivated and grazed with cattle, a very marked improvement on the soil has resulted in every case.

(*ii*) Examples of deteriorated soil can be found on any large irrigation canal, especially near the main channel owing to seepage and percolation.

(*c*) This is a matter for local settlement in each case and no general rules could be laid down.

QUESTION 10.—FERTILISERS.—(*a*) Fertilisers could be used profitably to a much greater extent than they are at present on all capitalists crops and garden crops.

(*b*) I do not think there is at present any extensive fradulent adulteration of fertilisers.

(*c*) It is a matter for district propaganda work for the usual methods in each district.

(*d*) North Bihar for sugarcane.

(*e*) Investigation on the effects of manuring is required in every area. It is a matter which requires very much further extended investigation.

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*Not printed.

(*f*) I think that far too much fuss has been made over the practice of using cowdung as fuel. I think it is a question which might well be left alone.

QUESTION 11.—CROPS.—(*a*) (*i*) The ideal method of dealing with the question of the improvement of an existing crop in an area is, first of all, a survey by a qualified botanist possibly helped by an experienced agriculturist, then botanical work at headquarters followed by the establishment if necessary of seed farm and demonstration plots. Where such procedure is not possible a great deal can be done for the improvement of existing crops by every agricultural station. Pure line selection can be done by every agriculturist of the staple crops with which he is working. It should be strictly laid down that this is an essential part of the duty of every station dealing with crops in India. Agricultural selection has been going on in the Pusa Farm for a considerable time and the special selections which are now being grown will be shown to the Commission.

(*ii*) One of the best examples of a new fodder crop is the introduction of *berseem* (*Trifolium Alexandrium*). This had been tried on small plot scale only in India previous to 1907. Suitable seed from the alkali lands of North Egypt was introduced into Sind during the following years and this valuable fodder crop is now found from the North-West Frontier Province to South India. It is an irrigated white clover and gives a heavy yield of succulent fodder from November to April-May where irrigation is available. It is a most valuable rotation crop and produces fodder abundantly during the critical months before the break of the monsoon.

(*iii*) and (*iv*) are local questions.

(*b*) In many cases it is quite possible to substitute a heavier yielding food crop, but before this can be done with safety, local conditions must be thoroughly investigated. In most districts there is cast-iron custom as to the staple food grain, and if another grain is grown it may be found that there is no demand for the new grain. For example, in a *juar* eating tract, *bajri* will not be eaten. So also a heavy yielding rice may be entirely unsuited for the consumption of a particular tract.

(*c*) Three of the most successful efforts of improving or substituting more profitable crops are in my opinion the following:—1. American cotton in the Western Punjab; 2. Coimbatore canes in North Bihar; 3. Pusa wheat all over India.

QUESTION 12.—CULTIVATION.—(*i*) This is a local matter.

(*ii*) In all rotations more importance should be given to leguminous fodder crops especially in irrigated land and the possibility of grazing of these crops by cattle should be considered.

QUESTION 13.—CROP PROTECTION.—I am of the opinion that present measures are suitable provided that provision can be made for immediate expansion under circumstances of necessity.

QUESTION 14.—IMPLEMENTS.—The question of the smaller agricultural implements is a domestic one as the requirements, say in the case of ploughs, vary according to the district, nature of land and other factors. There are several Indian manufacturers of ploughs, etc., and they have sold considerable quantities of cheap ploughs modelled on samples imported from abroad. The copies are quite good though somewhat roughly finished, but they are wanting in the fact that the plough bodies and shares are made of a poor class of metal which quickly wears out. For plough shares a high carbon content steel is required if the plough is to last for any length of time. The local manufacturers in India should be encouraged to use a better class of material.

The larger and costly agricultural machines suitable for special circumstances and large landowners, etc., are more a matter for the Central Government. There are a number of difficulties to the spread of such implements and machinery. In some cases, the proper type of machine has not yet been evolved. In my opinion when agricultural machinery of a type suited for a particular purpose has been proved successful, there will be no difficulty in getting it taken up as a commercial proposition. Such machinery is not likely to be manufactured in India in the near future. It is very specialised work and there must be possibilities of large sales before any manufacturing engineering firm will evolve a new type. In the past there has been many failures, as the actual manufacturing firms are not in touch with local conditions. They usually employ agents at the big ports, that is Bombay and Calcutta, and these agents also are frequently not in touch with local conditions. They carry as a rule a very limited stock of spare parts and they are chiefly concerned in getting a cash sale without having any particular care as to whether the machine is suitable or not. A very important problem at the present moment is the production of a suitable threshing machine. There is nothing at present in the market which actually is suitable for conditions in the wheat tracts of North-West India. I have been working on this problem a number of years in conjunction with several implement manufacturers in Great Britain, but I have not been provided with sufficient means to make any great progress. An attempt was made in the year 1919 to get the Society of Motor Traders and Manufacturers to hold agricultural tractor demonstrations in India. This would have been of great value in bringing out to India actual manufacturers of agricultural machinery who could have seen the market possibilities at first hand. An example of the extended use in India without any Government action or propaganda work is that of the almost universal use of rice-hulling machinery. All conditions seem to me favourable for rapid and extensive use of harvesting and threshing machinery for the large wheat areas, provided the proper type of machine is available. India is one of the few large wheat growing countries where the grain is cut by hand and threshed with bullocks.

As a prime mover the steam engine is possibly most suitable to India than small internal combustion engines. This applies to agricultural tractors.

QUESTION 16.—ANIMAL HUSBANDRY.—(*a*) The methods for improving livestock depend largely on suitable financial equipment. Work so far has merely touched the fringe of the subject. There is necessity of central co-ordination as well as prosecution of the work already started by various Provincial Governments. The whole subject was pretty thoroughly gone into during the last Board of Agriculture at Pusa by a special Livestock Committee and I heartily supported the resolutions come to at that time; copy* is submitted.

(*b*) The questions are chiefly of local significance.

(*c*) The period of extreme scarcity over the majority of India is at the end of the cold weather and up to the break of the monsoon. Cattle which survive are so emaciated that when the flush of grass comes on with the first rainfall, there is very considerable loss owing to digestive troubles.

(*d*) It is possible in many cases to grow fodder crops and where irrigation is feasible, leguminous fodder crops should be in all rotations. . Silage in pits and the storage of grass and *kadbi* would be encouraged by all means.

QUESTION 17.—AGRICULTURAL INDUSTRIES.—(*a*) This all depends on a number of local circumstances, the period during which bullocks are worked will be lengthened if the cultivator does carting work or uses bullocks for water lifting. The actual working days in Sind might amount to 100 or 120.

(*b*) and (*d*) I am not in favour of Government intervention.

(*c*) and (*e*) to (*h*) I have no suggestions on (*c*) (*e*), (*f*), (*g*), and (*h*), except the fact that there is always far more employment in Sind than there are labourers available and the same applies to Bihar. As long as this is the case, I see no reason for encouraging subsidiary industries.

QUESTION 18.—AGRICULTURAL LABOUR.—The measures to attract agricultural labour must vary in every district and no useful general rule can be laid down. It is not possible in all cases to bring labour from some tracts to others. For example, attempts to attract labour from Gujarat into Sind have been a failure in every case. The colonists either die or quickly

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*Not printed: *vide* Proc. Bd. Agr. in India held at Pusa in 1925.

leave the country. Punjabi colonists can live in Sind and immigrants from the desert country of Rajputana come to Sind each season especially in years of scarce rainfall, but they generally depart after staying only a short time with what wages they have accumulated.

QUESTION 19.—FORESTS.—The questions under this head are largely local, but in one case the destruction of forests on upland country which occurred gradually in Chota-Nagpur has not only led to soil erosion but the whole climate has altered. Early rainfall used to be frequent from April until the break of the monsoon. Instead, severe hot weather is found at this period so much so that it is not possible to plant out young tea bushes. So no tea gardens are now made in this area though there are several productive old gardens.

QUESTION 20.—MARKETING.—(*a*) to (*c*) I will confine my remarks to the question of wheat exported from India. This contains a large percentage of dirt; it also contains foreign grains such as barley, mustard and rape, it contains a mixture of soft white, medium white and hard red wheat all of which would obtain better prices if sold pure. Wheat is exported in bags and this necessitates very expensive handling, extra railway stock and huge dock areas as the bags have to be stored on raised plinths. The whole system is primitive and out-of-date. The trade interested however does not recommend any change and a thorough inquiry is necessary and very drastic action on the part of the Central Government.

(*d*) The method of posting market prices at the various markets as done in the Punjab for cotton and wheat seems to be a very sound piece of work.

QUESTION 24.—ATTRACTING CAPITAL.—(*a*) As a general rule, capital fights shy of agriculture in India though there is plenty of money available for special crops in approved districts such as tea. In order to get men of capital and enterprise to actually take up general agriculture, a change of attitude would be necessary on the part of those Provinces which have land to dispose of. At present no encouragement is given to outsiders. This policy is probably quite sound for political reasons.

(*b*) Owners of agricultural lands under the Permanent Settlement have little or nothing to do with the actual working of their property. They are practically nothing but tax gatherers. In other parts of the country, owners generally let their lands and it is very seldom that owners are found who actually cultivate their own land. A certain amount of good might be done if Government were to include in the Honours List rewards for cases of enlightened management and well conducted farming.

QUESTION 26.—STATISTICS.—Most of the statistics is dependent on the returns submitted by the lowest revenue official. In Sind this is the *Tapedar*. He is able to write his returns in the vernacular and is a very poorly paid man without any interest in the figures which he produces. Until a better medium is provided for the production of statistical material, I fail to see how any improvement or further complicated methods at headquarters will improve the situation. I inspected a case personally in Sind as to the returns about cotton cultivation and outturn. These figures remained constant year after year though it was obvious that there were large differences both in yield and in area grown. The actual figures of production were obtained from the cotton gins for comparison. It was found that the *Tapedar* usually put down 8 annas as a safe figure for his returns.

Mr. G. S. Henderson.

Oral Evidence.

A.988. *The Chairman:* Mr. Henderson, you are Imperial Agriculturist?—Yes.

A.989. You have provided the Commission with a note of the evidence that you wish to give. Do you want to say anything in amplification of that note before I ask you some questions?—No. I think it expresses all my views quite fully.

A.990. Would you give the Commission a short account of your own training and past appointments?—I have been connected with agriculture all my life. My father was a land agent and I was trained in the West of Scotland Agricultural College. I was assistant to Sir Patrick Wright for two years; I was in Canada for some time. I then went to Egypt as an assistant in a land reclamation company. From Egypt I got an appointment in the Indian Agricultural Service and was stationed in Sind for about 10 years. From Sind I was appointed Imperial Agriculturist at Pusa. I was on the Cotton Committee for a year and then I was sent to Mesopotamia as a Special Commissioner along with Sir Thomas Ward, who was head of the Irrigation Department. From there I was put on special duty on the Indian Munitions Board. After that I went back to my substantive appointment and was on deputation in England for several months to organise motor tractor trials in India. Since that date I have been stationed in Pusa.

A.991. Would you tell the Commission whether you think Pusa a suitable site for this Institution?—I consider it should be one of several sites; I do not think the Institution or the Imperial Department of Agriculture should be confined to any one site.

A.992. If this scheme of instituting several stations at various places were carried into effect, would you suggest that one of those stations should be a headquarters?—I think possibly it would be better to have headquarters in touch with the Government of India and not necessarily at a station.

A.993. How about post-graduate training; that would have to be concentrated at one station or another, would it not?—I think the ideal form of training would be to have a certain time at several stations.

A.994. Upon the assumption that only one station is to exist, what do you say about the suitability of the site at Pusa?—It is not a good site.

A.995. Why?—It is hopelessly out of touch with the rest of India.

A.996. It is difficult of access?—Extremely.

A.997. Would you attach importance in the choice of a site to its accessibility to visitors coming to India as well as to persons resident in India?—I think that is a most important point.

A.998. *Sir Henry Lawrence:* Do you say it is a most important or the most important?—A most important point.

A.999. *The Chairman:* Then you look forward, I gather, to a day when the institutions carrying on research and responsible for demonstration in India will be in far closer touch with like institutions the world over?—Yes.

A.1000. *Professor Gangulee:* Do you think that difficulty of inaccessibility can be overcome?—If railway facilities were improved or a bridge built across the river, it would be greatly improved.

A.1001. *Sir Henry Lawrence:* Or aeroplanes?—Yes.

A.1002. *The Chairman:* What exactly is the extent of your personal responsibilities?—I am primarily in charge of the farm and the cultivation of the whole of the area except some small pieces which are in charge of the various Sections. I am called upon to advise on purely agricultural subjects practically all over India.

A.1003. Are you ever called upon to advise upon problems of propaganda and demonstration?—I have done.

A.1004. Are you responsible also for keeping the records of experiments carried on on the farm?—Yes.

A.1005. Men come and go, and it is very important, is it not, that records should be both accurately kept and readily available?—It is most important.

A.1006. Are you satisfied with the system of recording experiences?—I think the staff is not quite adequate.

A.1007. Is the system sound?—I think the system is quite sound.

A.1008. Do you depend to a great extent upon articles in agricultural journals as records of events, or do you record matters on some definite system of filing or indexing?—Articles in journals as a rule are merely abstracts or summaries; they do not give elaborate series of figures; the figures on which results are based are kept in the office.

A.1009. Do you find that you are able to turn up facts that are required expeditiously?—Yes, we have no difficulty about that.

A.1010. Turning to the note of your evidence on the first page you say it is your opinion that the first step towards progress should be that of setting the administration in order and that an orderly survey should be made of the means available for an organised attack. What exactly do you include there by the word " means "?—All existing agencies.

A.1011. I wondered whether you were thinking of finance as well?—And finance.

A.1012. Have you any suggestion to make as to how money might be provided for a campaign of this sort?—I should think the first step would be to bring the necessity of it to the attention of the public and specially to sections of the public; for instance, a trade problem, if it were properly represented, would in many cases get very ample support from the trades interested.

A.1013. Do you think the public, whether through corporations or by private subscriptions from private individuals, might make an important contribution to the funds required?—I think they would.

A.1014. I see you attach importance to the question of grading of export crops and you suggest that drastic legislation may be required to raise the standard of Indian agricultural exports. Do you think the time has come for an attempt to fix what I may call All-India standards for exports?—I think it is high time.

A.1015. That would mean action of a disciplinary nature at the ports probably, would it not, judging by the experience of other countries?—It would probably have to go further back. In some cases the crop would have to be dealt with before it came to the port.

A.1016. So that the action required to improve the quality has got to be taken at a stage far removed from the port?—Not necessarily, because in the case of cotton a certain amount has got to be done at the gin which, in every case, is really the nearest point to the cultivator.

A.1017. On page 124 you say, " It would be a thousand pities to see a number of different agencies all working independently and not using their energies in the best possible manner." Do you envisage the possibility of combining all the existing agencies under one supervising head?—I would not go so far as that but I should certainly think there ought to be much more co-ordination.

A.1018. Take the Indian Central Cotton Committee. What do you think of that organisation?—I think it is a very sound thing. I was responsible for the drafting out in the first instance.

A.1019. Do not let modesty stay your hand. Tell us if you are satisfied with your work now that you see it in being?—I think it is rather apt to go too far. I think when it was originally established it was the only possible means of carrying out a certain object; but I think, however, that it is only in the nature of a temporary measure.

A.1020. What makes you think that?—If the Indian Central Cotton Committee expands as it is doing just now and gets in a staff, that staff might be working without any co-ordination with other agricultural workers even in the same Province. You might have a Cotton Botanist working on cotton and quite close you might have a Wheat Botanist working on wheat; the same man might quite easily be doing both things.

A.1021. You would not favour the idea of a committee having particular organisations devoted each to one part of the country?—Yes, if they are coordinated; but if the committee is going to be independent, then I think it is not a step in the right direction.

A.1022. Is one of the advantages of the Indian Central Cotton Committee this that it brings the growers and the intermediaries who carry on the distribution of the crop, those who process the crop in various stages and those who export it, into touch with each other and the Government?—I think the great advantage is that it brings the cotton worker, the trade and the Government into touch, but I do not think that it fully represents the interests of the cultivator.

A.1023. Can you suggest any means whereby the cultivator might be more adequately represented on the organisation?—I think that would follow if you had more co-ordination.

A.1024. More co-ordination between what?—More co-ordination between the Central Committee and the different Provincial Agricultural Departments.

A.1025. Do you think that the Committee is the body best qualified to speak for the cultivator? Is that your point?—No; I think the provincial departments would be better able to do that.

A.1026. Not necessarily the Imperial Department?—No.

A.1027. Do you wish to say anything about agricultural education?—No; I have not had much experience.

A.1028. Have you anything further to say about demonstration and propaganda? Have you much experience of that side of the work?—I had when I was in Sind, but since I have come here I have not had much experience.

A.1029. Do you form the view that the demonstration and propaganda organisation in the Provinces is as efficient as the research organisation?—I think it tends to lag behind.

A.1030. Is it because those responsible tend to spend more of the money that is available upon research than upon propaganda and demonstration?—I think that is so.

A.1031. And after all, propaganda and demonstration form the essential link between the laboratory or the experimental field and the cultivator?—Yes. I think the importance of technique (good farming) is sometimes lost sight of.

A.1032. I have one or two questions on the organisation at Pusa before I proceed to deal with your ideas on administration. Are you satisfied with the co-ordination of departments within the organisation at Pusa?—Yes.

A.1033. Is it one of your responsibilities to see that there is sufficient coordination between department and department at Pusa?—No; that is the work of the Director.

A.1034. But you are satisfied with the degree of inter-connection and inter-communication that exists?—I think it is very satisfactory.

A.1035. What have you to say about the co-ordination between Pusa and the provincial agricultural organisations?—I think it varies very considerably. We are in very close touch with some Provinces, but in other Provinces the case is quite different.

A.1036. How do you account for the difference between Province and Province in this respect?—In some cases a Province wants the advice of a man who has had experience in that particular Province. For instance, the advice of a man who has had his training, say, in the North-West of India would be discounted in Madras, and this is especially so in my particular Section.

A.1037. We spoke a moment ago about post-graduate training. Have you anything to say about the desirability of establishing at Pusa, or wherever the central farm may be, an active and efficient organisation for post-graduate training?—We can as at present constituted, give a very good training here, with certain limitations.

A.1038. You are satisfied with the equipment for that purpose, I take it?—Only for a part of the training; not for a complete training.

A.1039. Are there not graduates undergoing post-graduate training at Pusa at this moment?—In my section two have been appointed and will shortly come to Pusa.

A.1040. Do you regard the figure of two as satisfactory for an All-India station?—I am afraid it is not in our jurisdiction in a way. These students are nominated by Provinces. We have no selective powers.

A.1041. Do you think that you are in a position to supply the teaching that is required? Do you think you are meeting the demand?—We have been meeting the demand as at present.

A.1042. Are you yourself satisfied with the figure of two? Do you think it shows that the school has a good name in India as a post-graduate school? —This place was never established for the purpose of a teaching establishment.

A.1043. Would you attach any importance to the establishment here of the tradition of post-graduate training?—I consider that Pusa from an agricultural point of view has been too much specialised to give a complete training. They might do part of the training here.

A.1044. Do you think that the establishment of a post-graduate school which would carry weight throughout India would be of advantage to the research side of the work of this Institution?—If we had the equipment and the means, certainly it would.

A.1045. In what respects do your equipment and your means fall short of the ideal?—In my own Section we have a staff which is only calculated to do the work without any educational duties to discharge. We have not any special staff for educational work and we are very short of buildings at the present moment. Only about two-thirds of my staff have quarters; I am not quite sure of the figure, but at any rate a large number of my staff have got no quarters.

A.1046. I will take you back to the matter of your notes. On page 125 you talk about administration and you say that the provincial agricultural organisation is developing unevenly. You say, "On the one hand we have the Punjab spending Rs. 14,00,886 in 1924-25 and on the other side Assam spending Rs. 2,72,768 and Bihar and Orissa spending Rs. 4,81,629." You do not contemplate Assam being in a position to spend for sometime as the Punjab is spending, do you?—No, but the proportion should be much higher.

A.1047. Do you know the conditions in Assam?—Yes; I have been in Assam several times.

A.1048. Do you think that Assam could find the money to spend a great deal more on agriculture than is at present being spent?—I think that the money could be found in Assam.

A.1049. Do you think that the stimulus of a fully developed central organisation acting in concert with the Assam Government might induce them to spend a larger sum of money each year? It that your idea?—Not only that but we would then be in a position to help them.

A.1050. To help them to find the money or to help them to spend it?—To help them with money and to advise them in the spending of it.

A.1051. Do you accept the Reforms of 1919 so far as they affect the provincialisation of agriculture as a subject, and its transfer as something lasting? —I am afraid I am not really in a position to give evidence on that point.

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A.1052. Then, to change the subject: I see on page 126 that you complain of being teased by the Government audit. Do you not see any means of escaping from them?—I think the audit might be more on a commercial basis.

A.1053. If you succeed in commercialising a Government department, then you will succeed in doing something which nobody has managed to do before. On page 127 you say, "central Executive authority has been found necessary in all parts of the world and a very good model for India to copy would be the Central Department in the United States of America." Are you familiar with the workings of the Central Department in the United States?—Yes; I spent six months in the States.

A.1054. When you say "executive authority outside the matters over which the central organisation has specific control," how much actual executive authority has the Central Department in America over the affairs of the States?—I will give you a concrete example. Some years ago there was a great cry about dry farming and it was published all over America what could be done in States like Texas. The result was that a large number of ranches were broken up and settlers were induced to come from the East and take up these areas on the specific advice of the States Governments. The Central Government then stepped in and established several experiment stations on the dry farm areas and they gave absolutely contrary advice to that of the State of Texas.

A.1055. They made public advice conflicting with that given by the State?—Yes.

A.1056. Is there any executive authority over the State?—I do not know.

A.1057. *Sir Henry Lawrence:* What was the result of the divergent advice?—It prevented a large number of settlers coming from the East and saved a lot of money.

A.1058. *The Chairman:* Probably if they had had any executive authority they would have exercised it in preventing the movement: but the position, in fact, is that they have no such authority. Do you wish to say anything about the problem of indebtedness amongst the agricultural population?—No.

A.1059. Do you wish to say anything about fragmentation?—No.

A.1060. In answer to our Question 4 (*c*) (*ii*) you say, "The present situation in India with regard to freight haulage, especially small parcels less than a truck load, can only be described as very bad." Is that a question of freights or conveniences?—In actual practice it may take a couple of months to get stuff up from Calcutta to Pusa.

A.1061. So it is a matter of service rather than of the freight rates charged?—Yes, the service.

A.1062. Further on you say: "In long distance hauls especially where there is a break of gauge, the situation is extremely bad." I take it, you speak feelingly from having to change more than once every time you come from Calcutta to Pusa. On page 123 in answer to our Question 10 on fertilisers you say: "Fertilisers could be used profitably to a much greater extent than they are at present on all capitalists crops and garden crops." What exactly is the "capitalist crop"?—A crop like tobacco, sugarcane, etc.

A.1063. *Professor Gangulee:* You mean commercial crops?—Yes.

A.1064. *The Chairman:* You mean money crops?—Yes.

A.1065. Your establishment here is engaged in developing better plants of various varieties. Better plants, I take it, have a capacity for taking more nourishment out of the soil than the poorer plants?—In the case of grain, that is so.

A.1066. Have you come across cases where disappointment has been caused to the cultivator because he has adopted your better varieties but has not appreciated the necessity for giving them more food?—Not frequently, but I have met such a case.

A.1067. Can you conceive of a case in which the fertility required to supply a particular variety of crop with sufficient nourishment, so as to insure that the land would not be progressively deprived of plant nourishment, would be so considerable as to make it hardly within the ryot's capacity to adopt it?—I think other factors come into play.

A.1068. You are, no doubt, familiar with that argument which has been advanced, are you not?—Yes.

A.1069. Now, in the matter of farm implements, do you feel that any substantial contribution is made towards the ryot's problem so far as that problem consists in improving his implements at this moment?—Yes, both directly and indirectly.

A.1070. Let us take "directly" first. In what way has it been met? —In many cases he has got an improved type of implement. I can give a case in point which happened in Sind. We introduced a new type of wooden plough. Last time when I was in that tract I did not see a single sample of the old plough.

A.1071. *Sir Henry Lawrence:* What type of plough was that?—It was an Egyptian wooden plough.

A.1072. *The Chairman:* Do you think there is a good deal more work to be done in that direction?—I think the work is only just begun.

A.1073. How is the problem being met by means described by you as "indirect"?—Take, for instance, cases like rice-hulling machinery. Rice-hulling machinery is very largely adopted and it is very largely to the benefit of the ryot. He indirectly gets a better price for his produce.

A.1074. I suppose the improvement of the breeds of draught cattle in India would probably be the most substantial indirect contribution towards the solution of this problem, would it not?—I think it is even better to prevent existing breeds from extermination.

A.1075. What do you think threatens the existing breeds with extermination?—In the case of the Saniwal cattle in the Punjab, the extension of irrigation has undoubtedly broken up the tracts which formerly supported large herds of cattle.

A.1076. You mean there are fewer cattle there now than formerly?—I do not say that.

A.1077. On this matter of cattle and the improvement of the breeds in India, do you think that a cross between European breeds and indigenous breeds is likely to make now, or in the future, a contribution towards the ryot's problem?—It might do it in the case where indigenous cattle are extremely bad. It has done it in a district round Patna.

A.1078. I do not quite follow you?—I say it has done it already in the district round Patna where the cross has been introduced and that particular strain of cattle is certainly better than the indigenous cattle.

A.1079. That is because the indigenous cattle were so very bad?—Yes.

A.1080. Could an equal improvement have been effected by the introduction of a better breed of indigenous cattle in that area?—I doubt it because the milk factor would come into play. This cross gave a much larger yield of milk and so it held its place.

A.1081. What breed of cattle are you referring to?—It is not a breed; it is only a strain. It is called the Taylor breed and various other names; but it is not a breed.

A.1082. That was a cross between a Kerry bull and indigenous cow?—I do not know whether it was Kerry or Shorthorn.

A.1083. *Sir Henry Lawrence:* When was that introduced?—I am not quite sure when it was introduced.

A.1084. *Sir Thomas Middleton:* It was introduced more than half a century ago?—Yes.

A.1085. *The Chairman:* Do you attach importance to the development of a dual-purpose animal capable of providing the maximum amount of milk and also providing males capable of effective work in the fields?—I think it is very important, but I do not think it is as important as the taking of all possible steps to keep existing breeds of cattle uncontaminated.

A.1086. Are you familiar with the work which is being carried on by Mr. Warth at Bangalore on animal nutrition?—Yes.

A.1087. Do you attach importance to that work?—I attach very great importance to it.

A.1088. Do you think there is a great field still to be exploited in that direction?—Yes; I think the work is only in its preliminary stage.

A.1089. Have you ever thought about the milk-yielding side of the problem in its relation to the improvement of the diet of the cultivator and his family?—In some districts it is a very important matter. They say that in Sind it takes five cows to keep a family. That is an example of a milk-drinking tract.

A.1090. On page 130, in answer to Question 17, you say, "there is always far more employment in Sind than there are labourers available, and the same applies to Bihar. As long as this is the case, I see no reason for encouraging subsidiary industries." That, of course, I take it, means that in particular tracts where there is sufficient occupation, you would not spend any money in popularising subsidiary industries. In that answer, would you include subsidiary industries, or rather spare-time occupations, carried on by the women?—I have been many years in Sind and I have seen cotton lying on the ground because there were not sufficient people to pick it, and the occupation of picking is very largely women's occupation. So, I do not see the need of spending money in that direction.

A.1091. In those particular tracts?—My evidence is entirely in regard to those tracts.

A.1092. On the same page you point out the fact that migration of labour from one district to another is difficult, because it has sometimes been found to be the case that such labourers do not thrive in the district to which they go. Is it really the case that colonists going from Gujarat into Sind have died?—Yes.

A.1093. What killed them?—Probably malaria and heat.

A.1094. They could not face it?—They could not.

A.1095. On page 131, in answer to Question 19 "Forests," you say, "The questions under this head are largely local, but in one case the destruction of forests on upland country which occurred gradually in Chota-Nagpur has not only led to soil erosion but the whole climate has altered." Do you know whether the meteorologists of these days support the theory that deforestation affects the climate itself?—I do not know. My evidence is based on what I have been told by planters who have been in that district for many years.

A.1096. You are talking about pretty old times?—Yes.

A.1097. I am interested to see what you have to say about the marketing of wheat from the North-West. Is there great fluctuation in the volume of wheat available as the exportable margin from year to year?—Yes, very great.

A.1098. Would that be a serious difficulty in attempting to attract capital for, let us say, the modern system of marketing by means of grain elevators and ships designed to load from elevators?—It seems to me that there is a large amount of money invested in it at present; fluctuations do not seem to affect trade at present.

A.1099. Are you thinking of grain elevators?—Yes, grain elevators.

A.1100. Is there a large amount of money invested in grain elevators in the North-West now?—Little; there is only one grain elevator, so far as I know, in the whole of the Punjab.

A.1101. In what is this capital invested?—Rolling stock, docks and plinth areas.

A.1102. You know, of course, that for a fully developed system of export by means of elevators, you have to have not merely elevators, but also your ships designed to load from elevators? Would it not mean a very considerable tying up of capital?—On the other hand, it would free a lot of capital which is at present invested in rolling stock, harbour works, and godowns.

A.1103. Do you think that capital could be made liquid by an operation of that sort?—I should think valuable dock land could be sold.

A.1104. Have you any experience of agricultural co-operation in India?—Very little.

A.1105. Do you form any view about its usefulness as a contribution towards the agricultural problem?—I am not in a position to speak on it.

A.1106. Are you interested in general education in relation to agriculture?—I am hardly in a position to give evidence on that.

A.1107. In the matter of attracting capital, how would you suggest that the Provinces who are interested to do so might encourage outsiders to invest capital in agriculture?—Where Government land is being given out, conditions might be made to enable people with capital and with the proper knowledge to buy a certain amount.

A.1108. Are you thinking of establishing men on the land with large holdings, men who might be called planters?—Yes.

A.1109. Do you think that would be in conformity with present day policy?—To a limited extent.

A.1110. Do you come into contact at all with agricultural matters in the Indian States?—I have been on several advisory tours to Indian States.

A.1111. Is it your experience that Indian States are ready to co-operate with Governments in British India for the advancement of agriculture?—The States vary very considerably in that respect.

A. 1112. Are there any costing experiments being carried on at Pusa at this moment?—Yes.

A.1113. Would you describe a typical one?—We take a unit and all the work expended in cultivating that unit is put down daily.

A.1114. *Professor Gangulee:* For each crop?—Yes, for each crop. We have got complete data, since this place started, of the cost of cultivating every field.

A.1115. *The Chairman:* That is the cost of cultivation?—Yes, and of bullocks, but it does not include any overhead charges.

A.1116. Have you got the value of the crop?—We have the value of the crop and the outturn.

A.1117. Am I right in thinking that in an experimental station it is difficult to draw conclusions from comparisons between the total cost of cultivation and the value of the crop, because you are concerned rather with the carrying out of a particular experiment than making money?—That is so; and other difficulties arise, because it is not the case of one experiment; we might have a whole mass of experiments one overlapping the other.

A.1118. *Professor Gangulee:* Do you take into consideration bullock power?—Yes.

A.1119. *The Chairman:* So that, as a contribution towards the analysis of the cost of the cultivator's work, you are not really going very far here at this moment?—No.

A.1120. Do you think that might be a very useful field of work?—I should think it would be very useful indeed for a provincial department, not for a central department.

A.1121. Has any work on sheep been carried on at Pusa?—We have had sheep here for some considerable time, but owing to extensive flooding which we get in Pusa, we have had much damage from liver fluke; so, it is not a good centre for sheep.

A.1122. Have you done anything with goats?—Nothing.

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A.1123. Is the goat an important animal in the agricultural economy of India?—Yes, it is important.

A.1124. You know the history of the improvement of milk-yields in particular breeds of goats in Europe?—I have read about it in agricultural journals.

A.1125. And the remarkable success it has attained?—Yes.

A.1126. Do you think that is a line which might be examined?—In some parts of India there are great possibilities for it.

A.1127. Have you considered at all the problem of whether the export of bones from India should be allowed or should be discouraged or prevented?—Under present circumstances, I would not be inclined to advise any interference with the export.

A.1128. *Sir Ganga Ram:* Not even an export duty?—No, I think I would not interfere in any way; not even an export duty.

A.1129. *The Chairman:* Are you familiar with the Military dairy farms?—Yes.

A.1130. Their cows are almost entirely first crosses between European and indigenous breeds?—They vary; in some farms they have got pure Indian cattle, and in others crosses.

A.1131. Their primary object is to provide milk for the troops?—Purely milk.

A.1132. Have you ever considered the possibility of the Agricultural Department taking over some or all of those farms?—I should be very sorry indeed to take over these farms.

A.1133. Why?—Because a lot of them are very badly situated.

A.1134. Have you coveted any of them?—One or two are very good; I would take Ferozepore.

A.1135. You think there is a case for taking that over?—I do not think so. If we took them over it would be in the nature of a compromise. I think it is very much better to acquire land and do the thing properly in the first instance.

A.1136. By compromise you mean that you have to undertake to continue the supply of milk and that will have to be carried on in conjunction with any experiment that you might wish to make; is that the point?—Yes; that is so.

A.1137. *Sir James MacKenna:* With reference to the organisation of the staff at Pusa and in the Provinces I see at one stage you say: "At this time the Heads of the sections at Pusa should have been raised to at least the grade of Directors of Agriculture and made responsible for the activities of their sections throughout India." Do I understand you correctly if I say you mean that you would have, at Pusa, the Imperial Agricultural Chemist as the Head of all the chemical work in India and the Economic Botanist controlling all economic botany in all the Provinces; that is the substitution in effect of several Agricultural Advisers for one, and with a great deal more power than the present Agricultural Adviser has? Is that your scheme?—Not exactly. I did not suggest that any section or extended section should have any power of interfering with the corresponding section of the Province; but that he should keep in touch with the work that his branch is doing in the different Provinces and be in a position to advise the Government of India on his particular branch.

A.1138. That is to say, you would have had advisers in all the branches of agricultural science, the Imperial Officer at Pusa advising on his particular branch of agricultural science to the Government of India?—Yes.

A.1139. In your experience of Pusa do you think that the Provinces would accept a scheme of this kind?—I fail to see why the Provinces should object; it is to their advantage. You instance the case of the Chemist. The Chemist probably is trained in a Province and he is in touch with the chemical work going on in all the Provinces and so he is in a position to advise the Government of India on his own branch. I think the Provinces will be quite pleased to have it.

A.1140. Is that your personal view or is that based on your actual experience? Have you found the Provinces so extraordinarily well disposed towards Pusa as to accept a scheme of that kind?—I have had no difficulty except in one or two instances.

A.1141. What is your view of the future organisation of the department in detail? How would you like the department to be organised with reference to Pusa?—My ideal is that the Imperial Department should not be so closely identified with Pusa. It ought to have stations in other parts of India.

A.1142. Then with reference to the Indian Central Cotton Committee, is it your view that the Committee has gone considerably further than what the Indian Cotton Committee had recommended?—Yes.

A.1143. You see a certain danger in it?—Yes.

A.1144. It has become too powerful altogether?—Yes.

A.1145. Are you in favour of entrusting special research on crops principally to the Central Committees and Bureaux?—I would have special branches of the Agricultural Department investigating special crops; but I would not give it over to independent bureaux. I would bring bureaux into the various branches of the department.

A.1146. You would insist on co-ordination of these bureaux? You are afraid they are apt to run away to their pet subjects and become rather too powerful?—Yes.

A.1147. Assuming that there was a centralised control of agricultural work in India, would you bring the Indian Central Cotton Committee under their control?—Absolutely.

A.1148. On the question of finance of these central bodies, you told the Chairman that you thought the trade could contribute as has been done in the case of the cotton crop. Do you think that will be feasible in the case of rice, for instance?—I think it would be to some extent. It has been done in the case of lac and cane to a certain extent.

A.1149. Would not the incidence of rice be rather unequal and fall rather heavily on certain Provinces?—Then the advantage would be to those Provinces more than to the others. But the amount is very small and I think it would not be a very heavy burden.

A.1150. You know the method of raising money for these central bodies by a form of tax or levy from the trade. Could not that money be earmarked for any particular crop from which it is derived?—I would not apply it to the particular crop.

In that case I must tell you what the case would be about rice. Even assuming a very low assessment, 80 lakhs of rupees would be paid by Burma alone and inter-provincial jealousy is likely to arise.

A.1151. One or two questions about your past experience. You had been Deputy Director for many years before you came to Pusa. Could you tell us in what way, if any, Pusa was of use when you were a Deputy Director yourself?—It was of very great use indeed. Mr. Mollison visited my place on three occasions. When he came to me on the first occasion I had not a bungalow in the place. After leaving me he went down to Bombay and saw the Government of Bombay and insisted on building me a bungalow. On the next occasion when he came he got a big grant for reclamation work and on the third occasion he got me more money.

A.1152. So the assistance was largely financial?—And advisory.

A.1153. But then he was Inspector-General. I want to know whether you got help from any particular section at Pusa during your Deputy Directorship?—As a matter of fact I did not get very much help because it was entirely a new department; Pusa had not been sufficiently organised to get much benefit from it.

A.1154. At present are the Provinces using your different sections?—Yes; a very large number.

A.1155. What problems of basic importance to agriculture are you looking to here? Will you just mention a few?—Cattle, upkeep of fertility and general technique.

A.1156. These are all enquiries of general importance to the Provinces as well as to local farming here?—Yes.

A.1157. Are there any other problems you have in mind that should be taken up on the agricultural side?—I should like to have increase of machinery.

A.1158. You think a lot of work can be done on that side?—Yes, but not necessarily by Pusa.

A.1159. Are there any limitations for the Provinces to fully utilise you?—I do not know of any.

A.1160. Are there not difficulties that have arisen under the new Devolution Rules in restricting the amount of touring and so on?—That comes under what I said about accounts.

A.1161. Now about your half-bred cattle, you hold annual sales here which are well attended and where very good prices are obtained. Are all these cattle inoculated by the simultaneous method before you put them up to auction?—Practically all. With a very few exceptions they are all simultaneously inoculated against rinderpest.

A.1162. Do you sell any cross-bred bulls?—No cross-bred bulls.

A.1163. Have there been any complaints from the buyers as to excessive mortality amongst these cattle as a result of rinderpest or other disease?—No.

A.1164. You have had no complaints from them that these cattle are more liable to disease than the ordinary cattle?—No.

A.1165. Are any obstacles put in the way of ingress to, or egress from, Pusa by the Railway Companies?—Yes. There are two Railway systems, the B. and N. W. Railway and the E. I. Railway and I do not think they fit in very well. Coming here from the Punjab, the Punjab mail comes in 20 minutes after the steamer leaves, which means staying the night in the station.

A.1166. Have no representations been made?—I believe representations have been put up but no action has been taken.

A.1167. Do you think that the teaching side should be extended at Pusa? Have you any ideas as to how you could improve it?—We should have a large number of short and special courses, for instance, in the installation of power machinery, the technique of cattle-breeding, fodder growing and so on.

A.1168. Do you foresee a day when Pusa will be able to give a complete post-graduate course in agriculture to qualify for direct appointments in the Indian Agricultural Service?—I should think it would be better if the course comprised a certain amount of training elsewhere in addition. I am talking especially of my own section and not of the scientific sections.

A.1169. How would you train these men for the Indian Agricultural Service?—In India now we have certainly got a nucleus for a very good training.

A.1170. Where?—Suppose they have taken their degree in one of the provincial colleges and they want to specialise, we will say, in cattle work, they can be given sometime at one of the Military dairy farms such as Bangalore, so long here, and a spell abroad.

A.1171. But would it not be better if we really had one institute where this class of teaching could be given, instead of waiting until one of the provincial colleges asserted its superiority and its position were recognised?—We could do it undoubtedly.

A.1172. Do you not think it has got to be done?—Yes; but I think the complete training should not be done here; I am talking from the point of view of the Agricultural Section.

Mr. G. S. Henderson.

A.1173. That is on account of the peculiar conditions under which you work here?—Yes.

A.1174. The limitations on the agricultural side?—Yes, you see we cannot give them any experience in irrigation.

A.1175. That is perfectly true. There is no wet cropping; so that really from the point of view of a complete agricultural course Pusa is unsuitable? —Yes, I think it is.

A.1176. It has these limitations?—Yes.

A.1177. *Professor Gangulee:* But you would have those sorts of limitations everywhere; could you select a spot where you would have all the facilities?—I would not select one spot, but I would arrange the course of training to get as many factors into the training as possible.

A.1178. Here you have already developed, if I may say so, a sort of scientific atmosphere; would you not prefer to utilise this institution for post-graduate training?—For part of the training but not the complete training. I think a man who is trained here and nowhere else would not be in a position to go all through India and be classed as a first class expert.

A.1179. Do you approve of the idea of developing Pusa as a post-graduate teaching institution?—Yes.

A.1180. Then if you agree on that point and if you have M.Ag. or M.Sc. students, do you not think you would have sufficient material here with which you could build up post-graduate agricultural education?—Do you refer to my section or all sections?

A.1181. The Institution as a whole?—I am not in a position to speak about the other sections.

A.1182. You refer to general technique in field experiments; are you working to develop a suitable plot technique?—Yes.

A.1183. For the purpose of carrying on experiments?—Yes.

A.1184. Do the members of the provincial departments visit your farm to study that technique?—They do on occasions; Boards of Agriculture and so forth come and study our methods.

A.1185. Most of the Provinces have to carry on experiments in the fields?—Yes.

A.1186. Are they familiar with your plot technique?—I should say they are, yes.

A.1187. Could you tell the Commission the procedure you adopt in planning your crop experiments?—I can give you full details; I am just starting a new series of plots on sugarcane in conjunction with the Imperial Bacteriologist and the Secretary of the Sugar Bureau. We are working on it just now and I can put all the documents at your disposal.

A.1188. Then you do consult with the other experts of the department?—Yes.

A.1189. In such field experiments you make an attempt to view the problem in all its aspects?—Yes.

A.1190. Do you attempt from an experiment to get complete data from all points of view? Can you tell the Commission whether you have carried on any experiments of that sort?—I am afraid I do not quite follow you.

A.1191. Let me explain. Supposing you are carrying on experiments with regard to the water requirements of a crop; you ask the Bacteriological Section to study the problem from the bacteriological side, you ask the Chemical Section to study it from that side, and you ask the Entomological Section to find out the incidence of pests in relation to water and so on; that is, when you tackle a problem do you try to get complete data in all its aspects?—Undoubtedly.

A.1192. Could you tell the Commission of any experiment that was done in that way?—We will take the permanent manuring experiment; this experiment was designed by the Board of Agriculture in India.

A.1193. You are referring to the Punjab field?—Yes. This experiment was designed by the Board of Agriculture but it has had slight modifications since that time.

A.1194. I noticed this morning in going about the fields that you were carrying on various experiments with leguminous fodder crops?—Yes.

A.1195. Have you asked the Department of Animal Nutrition to ascertain the feeding value of these crops?—When they have got beyond the preliminary stages, we take all the necessary steps to try that.

A.1196. So that you are in touch with the Department of Animal Nutrition at Bangalore?—Yes.

A.1197. Have you at any time undertaken any experiments at the suggestion of the provincial departments?—Yes.

A.1198. For instance, has Bengal asked you as Imperial Agriculturist to carry on an experiment which they were unable to carry out? Can you give us an instance?—We are doing quite a large amount of work for the Director of Agriculture in Bengal, chiefly on fibre work; we grow fibre for him, we ret it for him and send him the result.

A.1199. Are retting experiments done here also?—In the last series of experiments we carried out, we tried to extract a fibre by mechanical means; this instrument was designed at Dacca and it has been tried here.

A.1200. So you do carry on experiments here at the instance and suggestion of the provincial departments?—Yes.

A.1201. Besides Bengal, has any other Province come forward and made suggestions to you?—I have had suggestions from the Punjab, I have had them from Bombay and from the Central Provinces.

A.1202. So that in that way you are in touch with other Provinces?—In touch every way.

A.1203. Has it been possible for you to verify any results obtained by the provincial departments in their field trials?—I cannot give any instance off-hand in the case of crop trials. If, for instance, a new fodder is recommended by a Province, we give it a trial here and see how it fulfils our conditions.

A.1204. In your note you say, "it is my opinion that the first step should be that of setting the administration in order and an orderly survey made of the means available for an organised attack on the present terrible state of agriculture and livestock in India." Do you suggest that up to now there has been no organised attack on the agricultural problems of the country?—No, I do not suggest that, but I have a feeling that development is going on very unequally, and I suggest that a further amount of coordination would be of very great benefit.

A.1205. So that your point is this; there has been an organised attack but not sufficiently co-ordinated?—That is so.

A.1206. Or, if I may say so, there has been an organised attack without sufficient organisation?—Yes.

A.1207. Whose fault is that?—The whole problem of agricultural improvement is absolutely modern; it has not had time to get going.

A.1208. And you think "setting the administration in order" would solve the problem?—It would, certainly, if it were on a business footing.

A.1209. When you speak of setting the administration in order, what have you actually in mind?—I have this in mind; we will say within the last 20 years the subject of improvement in agriculture under modern methods has been really started. It seems to me that we are going ahead in a very unequal manner; some Provinces are doing very good work and spending a lot of money; other Provinces are doing very little. Various semi-independent and other organisations are starting, and it seems to me that we shall get into a state of chaos if we go on like this; it is time that the whole subject was systematically gone into and some idea obtained of the means available for carrying out the work.

A.1210. For that purpose you propose to have a central body?—Yes.

A.1211. Let me see how you would form that central body. Would you call the Imperial Department of Agriculture a central body?—It is a central body, yes.

A.1212. Then how do you explain this, that this Imperial Department of Agriculture, which you admit is a central body, did not succeed in establishing a system of organised attack on agricultural problems?—Because it has never yet had a chance. It is still in its infancy.

A.1213. After 20 years' growth it may be said to have reached the adult stage. On page 125 of your *précis* you state; "If the present state of affairs continues, some of the Provinces will have a very large organisation and will completely overshadow not only the other Provinces but also the agricultural machinery of the Central Government." Why are you alarmed at the possibilities of the Provinces developing a very large organisation?—I am not alarmed at all; I am only too pleased.

A.1214. Why do you think such development would overshadow and not assist the Central Government?—If they expanded to such an extent they would simply take all the best men away from the Central Government.

A.1215. There would be demand for better men?—Then the better men would be confined to a water-tight compartment. You would probably have your first class men in the Punjab and very inferior men elsewhere. There is no equality about the thing at all.

A.1216. Then, further on, you say with reference to Pusa that the body of scientific experts working in the Central Institute would have less and less connection with current agricultural affairs in India, as the development of the Provincial Agricultural Departments increased. I cannot understand why that should be the case?—That is only my opinion.

A.1217. Could you kindly explain why you anticipate this difficulty?—I anticipate that difficulty if you have an unequal growth of development in one place as compared with another place where you might have nothing at all. You would in that case get all your best men removed.

A.1218. But, in any case, if the tradition of Pusa is properly maintained there ought to be no danger?—I think there will be very considerable danger.

A.1219. Would you agree with me that such difficulties could not arise if the organisation of the controlling body of experts were made sufficiently elastic and the personnel engaged in research were properly selected?—That would undoubtedly go a long way to meet the case.

A.1220. Then with regard to the Institute, what definite proposals have you to organise Pusa so that the work on the central farm and the central research station can be made inter-related and inter-dependent, thus forming an essential structure in the agricultural organisation of the country?—I would extend Pusa by having stations in other parts of India.

A.1221. You make a reference to the Central Department of the United States. Is not that really a correlating agency? You say that it is an executive body. I think the Chairman pointed out to you that it was not. I was in the United States for some time and my impression is that it is really a correlating agency?—I am open to contradiction, but I was under the impression that they had essentially executive functions.

The Chairman: I said that as regards certain specific subjects; for instance the regulation of export and the duty of protecting the country against the importation of plant pests and the like.

A.1222. *Professor Gangulee:* Apart from certain reservations which the Federal Government make, the departments are quite independent and they have entire freedom in their own organisation and administration?—But if the Central Government wanted to carry out investigations I was under the impression that they had the power to step into that State and carry out the experiment by establishing a station in any Province.

The Chairman: At their own expense.

A.1223. *Professor Gangulee:* Without interfering with the work done by a particular State?—Yes.

A.1224. Here we have a note presented to us by the Agricultural Chemist to the Government of the Punjab and he also says that the State Departments have entire freedom of action in their own organisation and pursue their own independent lines of research. And further he says that they get material encouragement and assistance from Washington and that States vie with each other in the matter of catching the eye of the Federal authorities in receiving their grants. You said that you paid a visit to Canada. Have you had an opportunity of studying the organisation of the central farms of that country?—Yes.

A.1225. Could you very kindly tell the Commission how the work of coordination and organisation of these central farms is carried on in the different parts of Canada?—The station I was at was Guelph and they had a central farm there at which they tried new varieties. Then they had a chain of subsidiary farms in different districts and from there the improved varieties spread right through the whole tract.

A.1226. Yes, they are developing a very great deal. I saw some of their organisers at the Wembley Exhibition and that was the impression I was able to gather. You say the central body should include the Director of Agriculture. Would you not include the representatives of the Irrigation Department, or the Co-operative Department?—I would certainly include them. They would be essential for closer co-operation.

A. 1227. You make a remark about the use of cowdung as fuel. Do you consider the practice of burning cowdung a serious one?—My experience is confined to Sind and I think it is not a matter of very great importance there.

A.1228. Have you had any occasion to study the conditions in Bengal or Bihar?—Not in Bengal, but to a certain extent in Bihar. A lot of cowdung is got off the roads and from grazing grounds and so forth and it is almost always in a very dry condition. I do not think that it is a matter of primary importance.

A.1229. Have you an Agricultural Engineer attached to the Pusa Institute?—No; I attend to that branch.

A.1230. Have you any arrangements for testing different kinds of machinery?—I have tested several lots of machinery and several implements in different Provinces. I have tested the threshing machinery at Lyallpur; I have tested various things at Cawnpore and at Poona.

A.1231. Are you in touch with any Indian manufacturers?—I have seen factories in places near Dharwar.

A.1232. *Mr. Calvert:* One page 124 of your written evidence you say, "The whole question of grading of export crops needs thorough investigation." Might I ask why you lay stress on export crops?—I think the point of greatest importance is that improvement could be effected most quickly on export crops. The other point of view is that the grading of non-export crops would be attendant with very considerable difficulty. I think that immediate benefit could be obtained by taking up export crops.

A.1233. But any improvement in the marketing of export crops would only lead to a better price of the portion exported?—Eventually the cultivator would get a better price for his product.

A.1234. It would not reflect on the portion consumed locally?—I think it would, indirectly, in course of time.

A.1235. But the total proportion of agricultural produce exported is a very small part of the whole?—Yes.

A.1236. So that that leads one to the charge sometimes brought against the Agricultural Department that they devote too much attention to the export crops and not enough to the home consumption crop?—It would not be a sound piece of business not to start work where you would probably get the quickest result.

A.1237. In the case of Bengal rice, I gather none at all is exported. You could not improve the export marketing of Bengal rice?—No, I should think the department should tackle the question of Bengal rice by getting better seed and bettering the facilities for buying seed, helping in the manure, etc.

A.1238. Would you like to offer any opinion on the charge that departments devote too much time to the crops that go to Europe?—No, I do not think there is really very much in that.

A.1239. Just a point which Professor Gangulee took up about certain Provinces going ahead faster than others with the development of the Agricultural Departments. You would not go so far as to restrain their progress?—Certainly not.

A.1240. The mere fact, to take your figures, that the Punjab can afford 14 lakhs and Assam only 2 lakhs would not be an argument to keep the Punjab back?—No.

A.1241. Suppose that applied to Pusa, would you object to other Provinces going ahead if Pusa could not secure the funds?—No.

A.1242. I have not quite grasped the point of your argument here?—It seems to me that at Pusa the Central Government are lagging behind. We started with a certain ratio, as it were, and the expenditure was pretty even all over the Provinces; and now while some Provinces are going ahead, others are lagging behind.

A.1243. The main object of all these activities is the welfare and prosperity of the agricultural class?—Yes.

A.1244. As long as that end is achieved it does not really matter whether the work is done by the department here or in a Province?—It seems that it pays the Punjab to spend their money and they are pleased with the result, and if that applies to the Punjab it applies equally to other parts of India as well.

A.1245. Would not the success attained in one Province serve, as a spur to more laggard Provinces?—That is to be hoped for, certainly.

A.1246. I was not quite certain about the trend of these arguments?—The trend is that the Central Government should spend more money and keep up the organisation of the Central Government in proportion as expenditure increases in the Provinces.

A.1247. The argument is a local argument applied to the position of the Imperial Department?—Yes, that is so.

A.1248. And similarly, you say later on that all initiative would pass from the Government of India in agricultural affairs. Why should not the initiative lie in the hands of more progressive Provinces?—In the case of a problem which is common to several Provinces it is a case for the Central Government to act. I do not see why the Punjab, because it spends a large amount of money, should advise Provinces like Madras or Bombay; as long as they are co-ordinating their domestic problems they are absolutely within their right.

A.1249. But a great deal of work done in individual Provinces is of All-India value?—To a certain extent.

A.1250. But you want co-ordination of authority. Work may be carried on in the Punjab which is of value to Madras but who is going to be the connecting link? Is it your opinion then that the co-ordinating authority should also have with it a body of expert research workers apart from the provincial workers?—Yes, I think so, there ought to be a staff of sufficient scientific weight to act as co-ordinating authorities. For instance, if a chemical problem is being investigated in the Punjab which is of value to Madras, you must have a first class Chemist at the headquarters to translate it into practice, otherwise the work going on in the Punjab may never be heard of in Madras.

A.1251. You do not contemplate a time when the provincial departments will have extended to an extent which would render an Imperial Department unnecessary or redundant?—I do not see how that can be done very well because, if your expansion is so unequal, I do not see how it is possible to get rid of the Central Department.

A.1252. Take the case of your own department. What work are you doing now at Pusa which could not be done or is not being done in the Provinces?—Nothing. Everything I am doing could be done in the Provinces.

A.1253. It could be done by a provincial department?—Undoubtedly.

A.1254. In another place you suggest that the Heads of Sections at Pusa should have been raised to the grade of Directors of Agriculture. Were you thinking of their pay or of their official status?—Both.

A.1255. You do not think that their scientific reputation will be sufficient to give them the due weight?—No, I do not think it would be sufficient to give them due weight under the circumstances.

A.1256. Coming to the question of new crops, you say on page 129, "In most districts there is cast-iron custom as to the staple food grain." Do you not think you are a little too rigid there in view of the change of diet that is taking place in various Provinces?—I can only speak from my experience. I have known a case where in a *bajri* tract they would not eat *juar*, and in a rice tract they would not touch wheat. I have known of cases where new rice has been brought in from some distance and the people in that tract would not touch it.

A.1257. That may be merely the objection to something new?—I do not say the custom is unalterable, but I say it is very strong.

A.1258. It is hardly cast-iron; you have expressed it a little too strongly?—I do not mean to infer that it is absolutely unchangeable, but it is a difficulty in the introduction of new crops in many cases.

A.1259. Still, there is considerable evidence that new crops are being introduced and people are altering their consumption in response to them?—I do not mean to infer that my remark applies to all the new crops. In many cases when you bring in a new crop it is taken up with avidity; but I say that in some cases it does occur.

A.1260. Are you barring agricultural improvement through the introduction of new food crops?—Certainly not; I have merely pointed out a difficulty which exists in some cases.

A.1261. But it is not universal?—No, it is by no means universal.

A.1262. For instance, potato is spreading very rapidly?—Yes, and Pusa wheat is spreading very rapidly. I have merely instanced that as an obstacle.

A.1263. But it is not an insurmountable obstacle?—No.

A.1264. Now, with regard to the question of Animal Husbandry. Do you think that the sentimental view with regard to the cow is a bar to an improvement in the livestock?—I consider it a very great bar in some tracts.

A.1265. It is a great difficulty?—Yes.

A.1266. You say that the actual working days of bullocks in Sind amount to 100 or 120 days. Is that a guess or is it a careful calculation?—That is a calculation based on one particular village of which I have got experience; it is actual fact.

A.1267. On the question of marketing of wheat you say that "the trade interested however does not recommend any change and a thorough inquiry is necessary and very drastic action on the part of the Central Government." Do you stress the word "Central" there or would you allow Provincial Government to make the inquiry?—It struck me that it was a problem common to several Provinces. It is not only the Punjab problem but it is also the problem of Bombay and the United Provinces.

A.1268. Still the problem is sufficiently big in a single Province to justify an inquiry?—Undoubtedly.

A.1269. And actually the inquiry is being made by the North-Western Railway which is an Imperial department, but it might again be taken up by a provincial department?—Yes.

A.1270. Would you kindly let me know what you consider is the change of attitude necessary on the part of the Provinces in order to attract capitalists to take up agriculture?—In some Provinces it is more or less a settled policy not to encourage people from outside that Province to take up land.

A.1271. You are thinking of the Punjab probably?—As a matter of fact, I was thinking of Sind.

A.1272. What change of attitude do you want?—I do not want any change of attitude; I have merely suggested that that would be necessary if outside capital were to be attracted. I do not recommend it.

A.1273. On page 131 you say, "It is very seldom that owners are found who actually cultivate their own land." I presume you mean large owners? —I was referring to this side of India; this side of India is very exceptional.

A.1274. Could you make any suggestion as to how these owners could be encouraged to take a more active interest in agriculture?—I think Mr. Sayer made a suggestion sometime ago that if the Honours lists were more used for cases of advanced agriculture, that might help a bit.

A.1275. You do not think that has been done sufficiently now?—No. I know from my own experience as a Deputy Director in Sind that a recommendation, say, from the Police Department or from the Irrigation Department went very much further than a recommendation based on the fact that the man was a good zamindar.

A.1276. An opinion has recently been given by the President of the Science Congress that these new crops do not take more out of the soil than the old crops; that it is merely a question of getting a more efficient plant machine. Do you agree with that?—That can be absolutely proved or disproved by chemical analyses.

A.1277. What exactly is the general ideal that you are aiming at in the Agricultural Section? Is it to get crops which will make better use of the soil, ripen more quickly and take up less time, or to get a crop which will give a bigger yield?—There are several factors. In some cases it would be a matter of expediency to get a crop which could mature with less water; in some cases it would be more expedient to get a higher yielding crop; it is not always the same aim. The object might be to get an early ripening crop as we do here in Pusa. In many cases, I should think that if your crop gives a higher outturn, even at the expense of reducing the fertility, it is sound business to get a higher outturn and an immediate return unless fertility is going to be reduced very considerably; it is better to have the money at once if you can get it.

A.1278. One of the pieces of evidence given to us is that improved varieties require more careful cultivation and better manuring; is that generally true?—I do not think it can be laid down as a general rule. It may be so in some cases, but unless the difference in yield is very considerable, I do not think there will be very much difference in the effect on succeeding fertility.

A.1279. As to the question of Honours, do you not think people will give up their farms when they get their Honours?—I should think it would have a very good effect in the district. After all, the same principle might apply in giving an Honour for anything.

A.1280. Do you think it might be of real permanent value?—I should think so.

A.1281. Do you not think that a certain class of men does work for Honours and a certain class of men does work for the sake of work, and that the latter is often the better man?—The man who recommends him is responsible for selecting the proper type.

A.1282. I should like to make the question about costings more clear. Is this inquiry in which costing is being done under your control?—We keep a record of all the costings of all the crops of this farm.

A.1283. Of the farm you showed us this morning? How is it entered up everyday? Do you enter the hours of labour?—We enter the hours of labour, the number of bullocks used and the actual operation.

A.1284. How are you going to assess the value of the work done by the bullocks?—If a pair of bullocks work for half a day, we put down their rate for half the day.

A.1285. Then you are putting down a conventional rate for the bullocks?—Yes.

A.1286. How is that arrived at?—On the basis of our experiences and also on the basis of what it costs to hire a pair of bullocks.

A.1287. But you have just said that you found that bullocks were used only from 100 to 120 days in a village. Assuming that to be correct, you have got to allow somehow for the cost for 240 or 260 days?—If you will read my evidence you will find that my figure refers entirely to Sind. We can get quite a good basis of comparison by the rate it costs us to hire a pair of bullocks. Of course, we hire a number of bullocks and we know the rate at which they are hired.

A.1288. That would not give you the cost of cultivation?—It gives an idea of what the bullocks cost.

A.1289. That would give you the cost of hiring the cultivator's bullocks, not the cost of cultivation?—That is what we have done so far.

A.1290. You are not trying to work out the cost of keeping a pair of bullocks for a year and dividing the cost by the number of days they work?—We have sufficient data to work it out quite easily.

A.1291. Are you in favour of a more intimate study of rural economics in this country?—Yes.

A.1292. Do you think it would be of value to you in your work?—It could not be of very much value in my present post, but I think it would be of great value generally.

A.1293. The major part of this country is cultivated in small holdings up to about 12 to 15 acres. Do you think the methods you are working out now are suitable for the small cultivator?—No.

A.1294. As far as I have seen, practically no attempt is being made to work out the type of cultivation suitable for these small holdings?—That, I presume, is being done by the Provinces.

A.1295. We have not yet found any Province where it is done. This machinery which you showed us is not suitable for the 3-acre man?—No.

A.1296. There is nothing being done here to try and improve agriculture as it is understood by 90 per cent of the agriculturists?—We are working on specialised problems. But although, as you say, the larger proportion of Indians cultivate it in very small fragments, still there is a very large amount which is cultivated in big estates.

A.1297. Big estates form a very small percentage of the total area?—And when you come to dairy work, it will have to be on a big scale.

A.1298. It practically means dairy work is outside practical politics?—No; I would not agree with that, because the milk supply of cities like Bombay and Calcutta must come within practical politics.

A.1299. You are not working out any model to copy?—The improvement of milk supply is the important point.

A.1300. Do you think there is any connection between this concentration of the various Agricultural Departments on large scale farming, and the failure of graduates of agricultural college, to take to agriculture?—I do not think there is any connection.

A.1301. You do not think the fact that agricultural graduates do not take to agriculture is because the agriculture they have learnt is not suitable to the Province in which they live?—In the first place, you cannot teach practical farming in any educational institution; you have got to learn out in the open; you cannot teach business in an educational institute.

A.1302. When a man takes to medicine, he practises medicine, and a man who learns dentistry practises dentistry?—Before an engineer qualifies himself, he has got to put in five years in the workshops as a fitter.

A.1303. It would not apply to surgery, or medicine, or dentistry?—I do not think you can call an average doctor a business man.

A.1304. We have never yet been told why it is that these graduates from the agricultural colleges do not take to agriculture, or why they are not being employed by the big owners?—That applies to other countries also; I do not think, as a rule, a graduate of an agricultural college in Great Britain takes to practical farming.

A.1305. What is it that is special in agriculture, when those who learn it make more money by preaching it than by practising it? Where does the difference come in between agriculture and every other form of education?—Agriculture is purely empirical; any scientific work you learn should be a help, but it will not take the place of practical technique, and you can only learn your practical technique by the sweat of your brow.

A.1306. You have heard of the proposal in the Punjab to allot land to agricultural graduates for a period of years?—Yes, I have heard of it.

A.1307. Do you approve of it?—I think it would be a very interesting experiment.

A.1308 Do you think it would be sufficient to give the practical training required?—I think you would get a certain number of good men out of that lot.

A.1309. It would add to the value of the graduate?—I think it would.

A.1310. Do you think it is possible to standardise agricultural machinery such as ploughs to an extent which would permit of mass production? We have been told that if you could have half a dozen types of ploughs for India you might get a great reduction in the cost price by mass production; do you think it is possible?—I have a great hope in it; I think it is a development which will occur in the future.

A.1311. Do you think it will be possible?—I have great hopes about it.

A.1312. *Mr. Kamat:* You had the advantage of service in Sind; you have also visited Egypt, and you have had considerable experience at the Imperial Institute here. I should like to ask you, in view of this experience of yours, something about the possibilities of Sind. I do not wish to put any hypothetical questions, but I cannot resist the temptation of asking you for an expression of your opinion with regard to the future possibilities of Sind. Do you think, under an improved agricultural system, Sind will approximate in yield to Egypt, say, for a crop like cotton?—There are some very great disadvantages which Sind labours under. In the first place, it has got a very bad climate; its hot weather is probably one of the worst in the world; some parts of Sind have got an extremely bad type of malaria, and it seems it is getting worse.

A.1313. *Sir Ganga Ram:* Even worse than Bengal?—I think it is worse than Bengal. Another point is that you have got a very small population. I believe the population of Sind is about five millions and the area is about 40,000,000 acres. It is a very scattered country, and in most cases the soil is inclined to be impregnated with alkali or *kalar;* but provided the population difficulty is got over and you can get the right type of colonists into Sind, I should think it has got great possibilities. For one thing, it starts off with a great advantage; it has got excellent drainage; the subsoil water is very low. Egypt suffers very badly. because the subsoil water is high, and it has got the greatest difficulty in getting rid of this drainage water.

A.1314. *Mr. Kamat:* You are aware that the Bombay Government are making a huge experiment, from the financial point of view, in the shape of the Sukkur Barrage. Do you think that will help the Province of Sind to improve matters and come up to the level of Egypt?—I am afraid it will take some considerable time. The difficulty, in my opinion, is the want of population.

A.1315. I want to take you to another general question which arises out of your remarks in the pamphlet* which you have placed in the hands of the members. While discussing the question of reclamation work and other work in Egypt and comparing it with similar work and its yield in the Punjab on page 9 you say, " It will only be by the adoption of suitable intensive rotations and the largely increased use of leguminous fodder crops and keeping and feeding increased numbers of livestock that the yields of irrigated land in North-West India will approximate more nearly to those in Egypt." You go on to say, " At present the average yields per acre in the Punjab canal colonies, especially on the older colonies, are very small and evidence seems to point to the fact that yields are decreasing." This is in comparison with Egypt. Do you still hold by that opinion?—Yes.

A.1316. This was written about 5 years ago. Are things improving or stationary, so far as your knowledge of the Punjab goes?—I think it still holds.

A.1317. Coming to your précis, you said you had only 2 graduates in your section receiving post-graduate training at the Imperial Institute here. Do you think matters could be improved?—We could train more if the Provinces sent us more students to train.

A.1318. Is it the difficulty that the Provinces do not send the students, or is it that your method of selection is defective?—The men we are training just now have been sent to us by the Provinces; they are members of the Provincial Service.

A.1319. *Professor Gangulee:* Out of how many applicants have you selected these 2?—Out of 3.

A.1320. *Mr. Kamat*: Does it not seem to you to be almost a tragedy that from a vast country like this there should be so few graduates coming up here, and that it reflects on the Imperial character of this department here?—The point is that if the educational facilities in the Province are so good, they do not need to send us men for training.

A.1321. Either the post-graduate training here must be carried on under more satisfactory circumstances, or it ought to cease, and the better course surely would be to have a larger number of graduates trained here. Have you not thought of the possibility of getting over this point, which perhaps has been due to methods of selection or some other consideration?—That does not apply, in my opinion. While this may not be a very suitable place from the agricultural point of view, from the point of view of other sections it may be a very suitable place. A man who wants post-graduate training, say, in entomology, is in quite a different position from the man who wants post-graduate training in agriculture.

A.1322. Have you any idea how many students go abroad to learn the same subjects which are taught here?—I have no information on that point at all.

A.1323. Are no figures collected?—No.

A.1324. Speaking about co-ordination, you have said that co-ordination between the Imperial Institute here and the Provinces varies from Province to Province. Where you thought such co-ordination to be lacking, have you ascertained its causes?—I do not think it is a case of lacking; people come to me if they think I can do them any good; if they do not believe I can do them any good, they do not come to me. I have given the example of Madras; they do not come to me on questions affecting agriculture, but they do come from other Provinces.

A.1325. In the case of Madras, for instance, when you say they do not come to you, have you ascertained the causes why they do not come to you?—Because they have got their own experts in Madras, who are probably much better qualified to advise them than I am. I have no special experience of Madras; my special experience is in an entirely different direction.

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* Not printed: Notes on Practical Salt Land Reclamation—Bulletin No. 91 of 1920—by Mr. Henderson.

A.1326. In that case, where for the time being, accidentally or otherwise, a situation like this arises, that is to say, an expert in the Province of Madras being as good an expert as at Pusa, there should be no complaint that there is not sufficient co-ordination, such a state of things is inevitable?—I do not know that there was a complaint.

A.1327. Then, in the case of those Provinces where the co-ordination is not as much as you wish, you have no complaint to make?—No.

A.1328. To come once again to this question of the administrative situation and your suggestion for revision of the position, I am not quite clear whether you have made the position clear or whether I quite follow you, in the light of the constitutional position of the country as it stands at present. Let us see how far we agree. You agree that as long as the Government of India Act stands as it is, agriculture must remain a Transferred subject in the Provinces and therefore the Province must be autonomous?—Yes.

A.1329. If that fundamental fact is accepted, the Government of India should have no right to interfere?—My opinion is that it should have no right to interfere with any domestic problem; but it should have the right to interfere where the problem is common to two or more Provinces.

A.1330. That is where we disagree. In any shape or in any form whatever, the two things are contradictory. If a subject is Transferred, constitutionally do you think it should remain in the hands of the Central Government even for purposes of the remotest point of interference?—I am afraid I cannot agree with you.

A.1331. Assuming that the Government of India should have no power of interference, should then the Pusa Institute have any power of interference, since the Institute is an advisory body either to the Central Government or to the Provincial Governments?—On broad lines my opinion is that it should have no power to interfere in a purely domestic problem. But when that problem ceases to be a domestic problem it certainly should have a right to interfere.

A.1332. In that case do you mean to say that a problem which is domestic in one Province and is also domestic in another Province becomes a central subject simply because it is common to two Provinces?—I do not follow you.

A.1333. You admit that a particular subject, say, a particular crop, is a domestic subject in one Province. It is also domestic in the adjoining Province. By mere virtue of the fact that the subject is common to two contiguous Provinces, does it become a central subject?—Yes.

A.1334. I think there again it does not seem to be perfectly clear; it is rather contradictory?—May I take a concrete point to illustrate my meaning? We might have a case where one Province was busy pushing out a certain type of cotton; this might be close to an area in a different Province where a very high class long staple cotton was being grown. By pushing this cotton out they might be radically injuring the good cotton and still, for political reasons, one Province might not be prepared to stop that cotton being pushed; that is a case where the Central Government should have power to come in and act.

A.1335. Yes, but act only in the shape of giving advice. But what you want is to go beyond the Government of India Act and invest the Central Government with powers of interference and initiative in certain matters which cut right across the very idea of the Government of India Act. Now about this proposal for revision of existing relations, there is some little contradiction in your suggestions. In one place you say, "It is hardly likely that the Government of India would ever interfere even in the remotest way with any purely domestic question in a Province." That is, you agree that so far as a purely domestic question is concerned, they should not interfere. But, in another place, in making suggestions on the lines on which the present administrative position should be revised you say, "The

Government' of India must have a strong central executive body to co-ordinate and to advise on all questions of an agricultural nature in India." I cannot understand how a body could be executive and yet give only advice and co-ordination. If it is an executive body it will interfere?—A body of that nature would, I think, never interfere except in the case of absolute necessity.

A.1336. Now the question is, even in the case of absolute necessity, should it have, constitutionally, the power to interfere?—It seems to me that if it is going to be purely advisory, its functions may eventually be practically null and void.

A.1337. In which case would there be any harm in giving the Government of India power to interfere in the matter of Transferred subjects in the Provinces? Or would it be better to leave each Province to advance as it likes? Which would lead to the more chaotic state of affairs?—I might give a case in point. A lac institute has lately been established near Ranchi. In the course of time they will have a fully equipped Chemist and possibly a Botanist. Within a short distance of that there is an experimental station of the Agricultural Department. You might get two Botanists working within a few hundred yards of each other and doing work which one might do, and these cases will undoubtedly be multiplied in the future.

A.1338. I quite realise your difficulties and I quite realise also your desire. I do not wish you to misunderstand me. What we both desire is to have co-ordination and a machinery for co-ordination. But that machinery, I say, should be on the basis of advice on the part of the Central Government and in no case should it be in the form of actual interference; and, if you agree, then our task would be to suggest what sort of machinery these should be to secure better co-ordination. Now in order to achieve this end, that is to avoid interference, yet to have co-ordination we have been told in some other place that the only machinery possible under the present Act would be a Central Advisory Board in which your Institute should have an adequate place. Would you be satisfied with that?—I am afraid that would not be sufficient to fulfil the case.

A.1339. You do not then agree with Dr. Clouston's suggestion to have a Central Advisory Board to guide the Government of India and, through them, the Provinces? Would that be an adequate machinery for the kind of co-ordination which you desire?—I am afraid it would not.

A.1340. In what respect would such a Central Advisory Board fail?—We have had a good deal of experience with the Board of Agriculture which meets periodically. It is composed of representatives from all parts of India. It meets and passes resolutions.

A.1341. Supposing we get over that difficulty where the deliberations result purely in resolutions and we frame also a machinery to give effect to the resolutions of this Advisory Board, would you be satisfied? That is to say, there would be a permanent Secretariat attached to the Central Advisory Board and through the Secretariat a certain amount of correspondence would be carried on with the Provinces in order to ensure action being taken on the resolutions. Would that satisfy you?—The point is this. I am not in a position to argue with you on points of politics as you know them very much better than I do; I am an agriculturist. But it seems to me the most direct way is that the body which is going to be constituted should have executive powers.

Well then, we differ fundamentally, I am afraid.

A.1342. *Sir Henry Lawrence:* On the question of the development of Sind, you say that you foresee difficulty in securing enough labour for the land under the Sukkur Barrage and you give some figures as to the population of Sind and the area of Sind. I think you said 5 million of population and 40 million acres?—Yes.

A.1343. You do not suggest that the Sukkur Barrage is going to command the 40 million acres, do you?—No.

A.1344. The actual area commanded is 7½ million acres, is it not?—Yes.

A.1345. I think the actual figure of population in Sind is 3½ millions and not 5 millions and about 2 millions would be living in that area?—Yes.

A.1346. Now can you tell me what is the amount of land cultivated per head of the population in other irrigated areas?—I cannot tell you off-hand. But it has been my experience that where you grow cotton, especially irrigated crops, you must have a fairly dense population.

A.1347. Will you agree that the area cultivated in places where cotton is grown is as high as 1½ to 2 acres per head of the population?—I think it is about that.

A.1348. So that the population of two millions may be able to deal with the cultivation of 5 million acres? Would you like to think over that?—I think it is on the small side. 5 million acres is the actual area of Egypt and the population of Egypt is much more than 2 millions, I think.

A.1349. Then Mr. Kamat got an opinion from you that the produce of irrigated land in the Punjab was decreasing. Is that a necessary result of irrigation, or is it due to some bad methods of cultivation?—I think it is due largely to economic conditions. They are rather apt to take too much out of the land in the first instance before they have got sufficient cattle, and they do not grow sufficient leguminous crops. But I think on the whole it tends to even up later on when the country becomes more settled. I base that evidence on questions which I put during the Cotton Committee to various officers and zamindars in the Punjab: they said that in their opinion on the older canal colonies yields were decreasing, in some cases very slightly, but still on the downward grade.

A.1350. Did you carry that further and ascertain the cause?—I put the cause down to the fact that wheat was very largely grown and that fodder crops were not cultivated in sufficient ratio.

A.1351. So that you would ascribe it to an improper ratio of cotton and wheat without the land being heartened by leguminous crops?—That is the basic cause in my opinion.

A.1352. But supposing you had a proper rotation with leguminous crops, is there any reason why the produce should decrease?—If a proper rotation is carried out and a heavy stock of cattle carried, all experience tends to show that the fertility will increase.

A. 1353. So that you want two factors; you want both leguminous crops and a sufficient head of livestock?—Yes.

A.1354. In regard to Sind, are you aware of what experiments are being made or are in process to ascertain the proper rotation of crops?—A considerable amount of work has been done already in Sind on this subject. There is a station at Sukkur on what was formerly very poor land but is now growing excellent crops.

A.1355. Is that station still maintained?—Yes.

A.1356. Are the lessons taught by that station propagated? Do people know of them?—The difficulty is this. An intensive rotation of that nature means a supply of water sufficient to grow two crops a year, and the conditions under which you can get the supply of water are at present limited. On the Sukkur farm the water is obtained by pumping from the river, and thus it can be regulated; but in any of the existing canals in Sind the amount of water is fixed and you cannot get more than this fixed ratio, so that it is impossible to carry out a really intensive rotation, but they get over that by having a large number of fallows.

A.1357. I do not fully understand. Do you think there are sufficient experiments being made now in Sind to prepare the way for the Sukkur Barrage?—A new station has been started but I have not seen that yet, but there is quite a lot of data available as to the result of intensive rotations.

A.1358. From the Sukkur and the Mirpurkhas farms?—Yes, and also to a small extent at Larkana.

A.1359. Have you ever advocated any further experiments being made in advance of the Sukkur Barrage?—In the Report of the Cotton Committee it is very definitely recommended that two such stations of at least 200 acres should be established.

A.1360. And what action has been taken on that?—One station has lately been sanctioned, but I believe they have already had difficulty about the water-supply, they put it in a place where it is not possible to get the water-supply as contemplated by the Indian Cotton Committee Report.

A.1361. Did you recommend any specific position for the other station? —No, we left that to the Local Government.

A.1362. *Sir Ganga Ram:* So that the experiment was not made?—The experiment has not yet been made.

A.1363. *Sir Henry Lawrence:* Is there any other situation that you know of in Sind where the water-supply is adequate?—The object was to reproduce post-barrage conditions, and that could have been reproduced by putting up pumps at certain selected sites on the river.

A.1364. And that is your recommendation?—That is the recommendation of the Indian Cotton Committee.

A.1365. Has that been communicated to the Bombay Government?—Undoubtedly, yes.

A.1366. But no action has been taken?—The action taken has been quite recently.

A.1367. But that is a different locality altogether?—Yes; our point in the Indian Cotton Committee was that it is essential to reproduce post-barrage conditions.

A.1368. In a recent meeting, I think of a scientific body, it was stated that the land in Sind was bound to deteriorate if it received heavy waterings; is that your opinion?—Who stated that?

A.1369. I think the President at a scientific meeting, Mr. Howard?—No, as the statement stands, it is not my opinion.

A.1370. What is the actual fact in your opinion?—Land can be damaged by heavy waterings if the water is improperly distributed; but the mere fact of putting heavy irrigation on land does not necessarily spoil it. Otherwise all rice land would be spoiled.

A.1371. *Sir Ganga Ram:* Does not heavy watering cause waterlogging?—It may, under certain conditions, but not necessarily.

A.1372. *Professor Gangulee:* It depends on the condition of the subsoil, does it not?—Yes.

A.1373. *Sir Henry Lawrence:* Did you find in Sind that the alkali there met with is soluble in water?—All the salt land of which I have had experience in Sind contained soluble alkali.

A.1374. And the irrigation can wash those salts down into the subsoil? —If you get sufficient irrigation you can wash it down into the subsoil.

A.1375. So that that is not a serious danger in your opinion?—It is a serious danger if there is not sufficient water; if there is sufficient water it is quite an easy proposition to wash the soluble alkali down into the subsoil in the case of Sind.

A.1376. Do you contemplate the establishment of a dairy industry in Sind?—I should think the dairy industry should be promoted by all possible means in Sind.

A.1377. I think you said that you were of opinion that a dairy industry would be of value to Sind?—Yes.

A.1378. Could you develop that a little more by giving grounds for it? At present in Sind there is a very good type of cattle called the Karachi breed. Do you expect that breed to spread to other parts of Sind?—I think when the canal becomes a going concern there will be a very big scope for dairying. It seems to me to be absolutely essential, on a canal of this nature, to have a large area of fodder crops and as there is an excellent dairy breed in the Province, dairying and fodder growing will go hand in hand.

A.1379. Do you consider that the people there know how to treat their cattle properly?—My experience of the Karachi district is that the breeders are efficient.

A.1380. Do they understand the principles of breeding cattle?—In my opinion they do; and they also keep a note of the pedigree to a certain extent.

A.1381. That is a very rare fact in India?—Yes, it is.

A.1382. And do you see any other advantages that the dairy industry would have in Sind over other parts of India?—As the Province developes under irrigation you must keep up the fertility of the land, and it is necessary to increase the livestock population, otherwise I do not see how the fertility of the canal area can be kept up.

A.1383. In Sind would there be the same difficulties about the disposal of young male stock as is found in other parts?—I should think there would be a considerable demand for young male stock of good breed.

A.1384. Now to come to this question, which Mr. Calvert raised, of the use of Pusa to India: you have no experiments here in rice?—No.

A.1385. What is the reason for that?—It is not a rice country. We have really no rice land on the Estate.

A.1386. Is not rice grown a good deal in this Province?—More south of the river and in patches north of the river.

A.1387. So that for reasons of soil and climate you have not been able to carry out rice experiments. Pusa is not suited for the purpose?—No.

A.1388. Rice is the most important crop in India?—Yes.

A.1389. The next most important is millets. Is that so?—Yes.

A.1390. Have you had any experiments on millets?—Yes, we have grown practically all the standard millets, and we have had them on small and large areas.

A.1391. Have you been able to devise any method of improving the millet cultivation?—We have not done very much work on millets. It is not the staple crop in this district.

A.1392. From that point of view again Pusa is not suitable?—No.

A.1393. Not suitable to the most important agricultural interests in India?—That is so.

A.1394. It is not because you were induced to favour export crops, the money crops, rather than the crops of internal consumption?—No; we have naturally taken up work on the crops which are indigenous to the tract to begin with.

A.1395. In regard to your visits to Provinces you say you have been welcomed in some places and not welcomed in others. Do you wait to be invited to go to a Province or do you announce your intention of visiting a Province?—Under the present Accounts Rules you have got to be invited practically.

A.1396. What Account Rule is that?—The Accountant-General puts difficulties in the way of passing any travelling allowance bill unless there is a very clear reason for going to a district.

A.1397. Which Accountant-General is that?—The Accountant-General, Central Revenues.

A.1398. And has that position of the Accountant-General ever been disputed?—I shall have to refer you to Dr. Clouston on that point.

A.1399. Since when has this objection been taken?—Within the last two years.

A.1400. Actually have your travelling allowance bills been refused by the Accountant-General for want of a specific invitation from a Provincial Government?—I will not go so far as to say that, but great difficulties have been created and questions have been put.

A.1401. In regard to experiments in cattle-breeding, you have tried crossing the local cattle with Ayrshire bulls. Have you obtained any other imported bulls?—We have had a limited number of American Friesian crosses but the majority of the crosses have been got by the Ayrshire.

A.1402. And the result of the first cross is very good in regard to milk supply?—Uniformly good.

A.1403. Continued crossing with the same Ayrshire, or foreign breed did not prove satisfactory?—That is so.

A.1404. Have you tried the further scheme of crossing with this year first cross-bred, the Sindhi, Montgomery or other Indian cattle?—We are now beginning on that work.

A.1405. You have not arrived at any conclusion yet?—As far as we have gone the results have been very satisfactory.

A.1406. That is quite a promising experiment. Has not that been tried in any other part of India?—I do not think it has been tried systematically on any large scale.

A.1407. Have you any knowledge of the experiments made by Mr. Borden in Texas, in connection with the importation of Indian cattle for the improvement of Texas cattle?—I have heard about them, but I have no personal experience. I am told they have proved quite satisfactory with regard to resistance to tick fever.

A.1408. That is to say, the quality is imported by the Indian sire and subsequently continued in the stock though the subsequent pedigree was entirely local. Does that not offer some hope for similar results in this country?—I think there is a promising field for that work but it must be done on a fairly large scale and there must be continuity of policy.

A.1409. Have you any knowledge of the milk question in Madras?—I have no first-hand information.

A.1410. Do you know that Madras milkmen attach considerable value to English blood in their milch cattle?—I have been told so.

A.1411. You have not had any opportunity of investigating it?—No first-hand knowledge.

A.1412. You showed us this morning some soya bean growing. Has that crop been successful in other parts of India?—Only as a fodder crop, not as an oil crop.

A.1413. Has it been grown for oil-seeds anywhere?—Only on a limited scale, as far as my information goes.

A.1414. Does it produce much seed?—Not a very big yield.

A.1415. But merely from the point of view of fodder it is worth growing?—It is very valuable in this place because it fills up the gap between maize and clover.

A.1416. During what months?—September and a part of October.

A.1417. For how long do you leave it in the ground?—It is sown during a break of the rains and is grazed in September and October.

A.1418. That is to say it is 4 months in the ground. How many grazings do you get from it?—Only one.

A.1419. *Sir Ganga Ram:* How long have you been in Sind?—I went there in the beginning of 1907 and left in 1916.

A.1420. In what capacity?—As Deputy Director of Agriculture.

A.1421. Do you know that the total population of Sind is only 3¼ millions?—I thought it was a little more.

A.1422. It may be a little more. During the last census it was 3¼ millions and already they have got ·93 acre per head of the irrigated area. In fact as regards the percentage of irrigated area they stand at the top of India?—That is so because you cannot cultivate without irrigation.

A.1423. I mean irrigated area without the Sukkur Barrage. Do you know anything about the qualities of the peasantry of Sind? Are they good peasants?—Not particularly good cultivators.

A.1424. For how many working class people is the area already irrigated sufficient?—I should say that the great majority of the people are directly connected with the land.

A.1425. What I mean to say is that you may safely say one million will belong to the cultivating class so that for one million you have already got one million irrigated acres. Do you think that the people want more? —I take it the idea is to colonise and that the new works bring in colonists from other Provinces.

A.1426. Is that the idea?—I think so.

A.1427. Have you made any research as to the delta of water required to mature each crop?—I have had a certain amount of experience.

A.1428. Could you give me a list of those experiences?—Yes, I will send it to you.

A.1429. Have you made any experiments as to what each crop takes away from the soil and what each crop gives back to the soil in chemical properties?—No, not absolute chemical properties, but I have to a certain extent judging by the state of the succeeding crop.

A.1430. You have not made any regular analysis after the crop is cut?—We have never had a Chemist in Sind.

A.1431. For want of staff?—Yes. There is only one Deputy Director of Agriculture in Sind.

A.1432. You say in your note that after sugarcane you sow maize. Is that the proper rotation?—That is proved by the result.

A.1433. Did you try cotton after sugarcane?—This is not a cotton tract. I grow cotton occasionally.

A.1434. What is there against cotton?—The rainfall is very heavy.

A.1435. What is the area of your Pusa Estate?—The arable area is about 600 acres.

A.1436. And you think that a little irrigation will not improve prospects of research?—We have a certain amount of irrigation which you saw this morning but the main portion of the farm is not irrigated because the land generally in North Bihar is not irrigated, and if we get results from irrigation these would not apply to Bihar.

A.1437. Have you got a contour plan of your estate?—Yes.

A.1438. Can you send it to me?—Yes.

A.1439. I should also like to have any experiences that you may have in regard to the chemical properties, *plus* or *minus*, of your crops?—My colleague Dr. Harrison would be able to give you first-hand information on that.

A.1440. Perhaps you may make a note of that also?—Very well.

A.1441. Do you know the discharge of this river which goes through your Estate?—No, I do not know its discharge.

A.1442. What is the source of this river?—It comes from a big lake up in Nepal.

A.1443. Have the Canal Department ever considered the possibility of making use of it for irrigation purposes?—I do not think it is a feasible proposition because it varies so much. It floods very large areas during part of the year.

A.1444. What is your difficulty in the winter season when the rains stop? —It would have to be lifted.

A.1445. Is it not a fact that in this area round about this river you are generally free from famine, but sometimes on account of the stoppage of rain you are confronted with famine?—I do not think we have ever been confronted with famine in this district.

A.1446. Is there any fall here? Is there any possibility of preparing a hydro-electric scheme?—The fall is very small indeed. It is so small that when the Ganges is flooded this river is headed up and it floods miles and miles of the country.

A.1447. Where is the fall?—Between this river and the Ganges.

A.1448. Do you know the velocity of this river or at least the fall in the river?—I have got no data on the subject. It is very small indeed. We are only about 60 feet above Calcutta level here.

A.1449. You said in your evidence that people eating *juar* would not take *bajri*, but the two things are grown in separate seasons. In Bombay they grow *juar* in the *rabi* season also?—My evidence applied solely to Sind.

A.1450. Not to Bombay?—No. I was talking about *kharif juar*.

A.1451. In Sind they do not grow *rabi juar*?—No.

A.1452. You recommend that Pusa wheat might be spread all over India. Have you any knowledge of the Punjab wheat which has now superseded Pusa wheat?—I have seen the different varieties grown at Lyallpur.

A.1453. Do you know that Punjab 8A is a better quality?—It depends.

A.1454. May I tell you the defect in Pusa wheat? It is not a very hard wheat for milling purposes and that is the reason why our 8A is very largely demanded; it is hard and just the quality for milling purposes?—Pusa 12 was a preliminary wheat. Quite a number of wheats are now coming on.

A.1455. Are they better than Pusa 12?—Yes.

A.1456. Have you ascertained any method of fixation of nitrogen from the air?—Yes, by means of leguminous crops.

A.1457. Anything else?—No.

A.1458. Not by very frequent ploughing?—No.

A.1459. Has not that led to fixation of nitrogen?—That I am not in a position to give an opinion on.

A.1460. How many times do you plough here for your crops?—For the *kharif* crops it all depends on various conditions; but we make it a rule to plough at least to 9 inches once in a year.

A.1461. Have you any section of the subsoil here?—Dr. Harrison has got that.

A.1462. Will you kindly make a note of that too?—Yes.

A.1463. In your written note you say there are 16 million acres under wells in the whole of India?—Yes.

A.1464. Have you any opinion to express on the necessity of grain elevators?—I should think they are absolutely bound to come sooner or later.

A.1465. Did you have any experience of them overseas?—I have seen them in Canada.

A.1466. How far apart are they?—There are elevators practically at every chief station on the railways.

A.1467. What I want to ask is whether the distance of carrying will not outweigh the advantages of the elevator? How far apart are they?—My recollection is that there are elevators at every station and these stations are probably 10 miles apart.

A.1468. Have you any experience of dry farming?—I have seen the dry farm stations in Texas.

A.1469. Is dry farming conducted because there is no rain?—Yes, there is very little rain. They do dry farming with a rainfall of under 10 inches.

A.1470. In parts of the Punjab where there is a rainfall of only 8 inches or 6 inches, do you think dry farming ought to be adopted?—You mean on *barani* tracts?

A.1471. Of course; there is no irrigation?—10 inches is the rainfall in Texas during the 12 months, whereas your rainfall is probably in a couple of months.

A.1472. Do they have rain throughout the year?—Yes.

A.1473. Does not dry farming require deep ploughing?—It requires very careful soil protection.

A.1474. Is not ploughing essential for getting good results from dry farming?—It has got to be deep ploughed at the proper time, otherwise you can do a lot of damage.

A.1475. For dry farming you will have to discover a particular kind of seed?—They have got special varieties of seed.

A.1476. Has any research been made in that direction in India?—There has been a certain amount of research. Professor Knight in Poona brought out a large number of American *juars* and tried them at Manjri in Poona.

A.1477. No dry farming experiment has been made in wheat?—They have got some wheat varieties.

A.1478. In America they grow wheat under dry farming?—Some of this dry farming has been done in India also at various times.

A.1479. You do not go in for fruit culture in Pusa?—We do.

A.1480. What do you grow?—We grow peaches.

A.1481. Do you make any researches on that?—Yes; a lot of work has been done by the Botanical Section.

A.1482. *Sir Thomas Middleton:* What proportion of your own time is spent in Pusa and what part of it in touring?—Since I came to Pusa I have been on deputation, study leave and touring for more than half of my time.

A.1483. Are your touring duties mainly made for advisory purposes?—Yes, chiefly for advisory purposes.

A.1484. To what extent does your association with the supervision of Pusa assist you in these advisory duties?—It assists me very considerably.

A.1485. Your previous experience was entirely in Sind?—And also in Egypt.

A.1486. You do find that the work at Pusa is of great value to you when you undertake advisory duties?—Undoubtedly.

A.1487. You suggest that there should be other research institutes similar to Pusa in various parts of India. Your first criticism of Pusa was that it was a single station whereas there ought to be several institutes. Had you any definite places in your mind when you made that suggestion?—I would certainly have one place in a centre where irrigation is practised, another centre representing Southern India, another centre representing Bengal conditions and possibly a centre in Central India.

A.1488. That will make four. Were you thinking of stations as extensive as Pusa itself or of smaller stations?—I was thinking of sub-stations.

A.1489. Assuming that for financial reasons one has got to be contented with a single central station, do you think you could find a better centre than Pusa?—If Pusa were abolished that would mean the loss of a tremendous amount of capital that is involved.

A.1490. I was not thinking of abolishing Pusa. You said you could much improve upon Pusa?—I think one could get a centre which is more typical of varying conditions.

A.1491. So far as I have heard, the chief drawbacks of Pusa seem to be the crossing of the Ganges and the metre gauge railway. If you take the quality of the soil of Pusa from the point of view of an experimentalist, what would you say about it?—It is of a very special type.

A.1492. These experimental plots of yours are extremely uniform; are they not?—Yes, comparatively so.

A.1493. If you were to compare the soil you have for experimental purposes at Pusa with the soil of the farm of the college from which you came, which would you say had the better conditions? You remember the Holmes Farm?—When I knew the Holmes Farm, the soil was very far from being uniform.

A.1494. Have you seen other experimental farms in Britain?—I have seen the Craibstone Farm in Aberdeen.

A.1495. I think you will find Pusa soil much more uniform than that at other experimental stations?—Yes, I have seen a number of American experimental stations.

A.1496. I have not seen any American stations. I am comparing experimental areas in Britain with your fields here. What place does the farming of the Pusa Estate take in comparison with other Indian districts; does it take a very high place?—I should think, on the whole, it has a very high place, it is very intensively cultivated.

A.1497. That is how it struck me in looking at it for the first time. It is, perhaps with one exception, the most highly cultivated area I have seen. Does not that seem to suggest that it is naturally a suitable centre for experimental work?—It has very many advantages, but in my opinion it is too specialised to be the one and only station.

A.1498. And you would correct that by establishing sub-stations?—Yes.

A.1499. We can see that in one respect it was unsuitable; you cannot work on the rice crop here. In reply to Sir Henry Lawrence, you indicated that your reason for not experimenting on millets was that the crop was not of local importance; but there is nothing in the soil which prevents you from taking millet culture up if you wish to?—The only point is the very high rainfall and the difficulty sometimes occurs, when you get an early rainfall, in not being able to cultivate later on.

A.1500. Apart from the 70 acres which you have under experiment, the produce of the rest of the 600 acres goes to the cattle. It is essentially a cattle farm?—Yes.

A.1501. And your cattle stock is very high, as judged from British standards. What are the reasons for the policy in concentrating on cattle?—The point is this; barring 200 acres, the rest of the farm is liable to severe flooding. I have seen even the College grounds a sheet of water.

A.1502. *Professor Gangulee:* Is that very frequent?—No, it is not very frequent; it occurs probably every third or fourth year.

A.1503. *Sir Thomas Middleton:* Your answer is that cattle farming is really the most suitable commercial line?—Undoubtedly.

A.1504. You do not think that a greater amount of mixed farming and the sale of cereals would pay you?—The trouble is the uncertainty of the season. This year, for example, we have had very little moisture; if we had grown any large area of wheat, for example, our produce would have been very low, but we do grow a large area of sugarcane on the farm.

A.1505. In taking up cattle to what extent were you influenced by the necessity for demonstrating the effects of selection of cows on milk production?—It seemed to be a problem which was of national importance and a fitting subject to be taken up at Pusa.

A.1506. What I want to ascertain is whether you went into cattle farming because the local conditions made it the most profitable type of farming, or whether you definitely aimed at demonstrating the effects of selection on milk production?—A certain amount of both.

A.1507. Your own work has shown that when properly fed, and selected with a reasonable amount of judgment, Montgomery cattle can be improved very rapidly; you have more than doubled the yield of milk in 12 years. Would you suppose that if similar methods were adopted for a number of Indian breeds you would get similar results?—There is the very outstanding result which was attained on the Surat farm by selecting Kankrej cattle. The Kankrej is a typical draught breed and is supposed to be only able to suckle its calf. After some years of careful selection on the Surat farm the Agricultural Department got cows giving 3,000 lbs. of milk.

A.1508. Can you tell me whether, in that case, the improvement was attributed to the regular feeding, or to the breeding?—I should think it was a case of feeding and selection.

A.1509. Just as in your own case?—Yes.

A.1510. Do you yourself attribute the success you have met with more to the regular feeding than to the selection, or is it the other way about? —I attribute it more to the feeding.

A.1511. *Sir Henry Lawrence:* What quantity of milk did the cows start from?—They were merely a selection from the Charodi farm; some probably gave 500 lbs. or 600 lbs.; it was under 1,000 lbs.

A.1512. *Sir Thomas Middleton:* Would you agree that it is of little use trying to provide superior bulls for breeding in India until the cows are better attended to and better fed?—Generally, yes; but in some tracts the cows are attended to.

A.1513. But in those cases in which the cows are neglected, it is really a waste of time and effort?—It is a waste of time. May I tell you of a case bearing on this point? I had to buy some Hansi Hissar cattle for Mauritius, and on the way down, while crossing the *ghat* one young bull got away and settled down in a village. We sent to that village and asked them to give the bull back and they refused. They said that the bull had come along of its own accord and they wanted to keep it. My Superintendent went along with some policemen and got it back by force, but the villagers followed them all the way to the station and offered Rs. 100 if they would let them have the bull. That is a case in point which shows that good bulls are appreciated.

A.1514. But those villagers presumably were looking after their cows carefully as in some districts they do; I can hardly think they would have followed your Superintendent and policemen if they had not been intent upon improving their cattle?—That is so.

A.1515. From the experimental work that is being done in India, you know almost exactly what the feeding of the cow ought to be in different districts. Has there been much propaganda?—It is only very recently that Livestock Experts have been appointed in the various Provinces, and I think it is quite safe to say that the propaganda work in most Provinces is now being carried on very strongly.

A.1516. *Dr. Hyder:* You attended the Conference held at Rome?—Yes.

A.1517. Do you think India is getting an adequate return for the contribution it makes to the funds of that Institute?—The contribution at present is very small; it amounts to about £800, and I think India is getting full value for £800.

A.1518. Could we make better use of the facilities provided by that Institute?—I think we could, if we could get a representative on the permanent Committee.

A.1519. Would you like that a member of your service, or a civilian who was about to retire, should be permanently at the Institute?—I should think it would be of the greatest advantage.

A.1520. Coming to Egypt, I find from the paper you have submitted that the reclamation of alkaline land in Egypt has been a success. We started level with the Egyptians in this matter; the Egyptians started work in 1888 and we started in about the same year. Why is it that the Egyptians have gone ahead of us? Is it due to lack of knowledge or lack of funds on our part?—I think the main reason is purely a financial one. When land in Egypt is reclaimed, it is of very great value. I stated that on Lake Aboukir near Alexandria, land which at one time was absolutely useless has been sold at £150 a *feddan*, that is practically an acre; it is agricultural land.

A.1521. £150 Egyptian?—Yes.

A.1522. So that, in course of time, you think that when the value of other land rises, this question of the reclamation of *usar* soil will solve itself?—I should think it is purely a commercial proposition. If the water is available, it is not a difficult proposition.

A.1523. Let us come to Sind. Have you any knowledge of the early efforts at colonisation made in the Punjab?—Not first hand; I had heard a lot from Sir Thomas Ward.

A.1524. Are you aware that the Punjabis were averse to going to the Crown lands irrigated from these canals? But when they had been shown the way, every Punjabi flocked to the colony, but not before that. Do you not think that the Sindhis, when they see that more money can be obtained out of it, will make greater use of the facilities provided by the Sukkur Barrage?—I think, in course of time, they certainly will.

A.1525. Would you make a distinction between a seasonal migration of labour and permanent colonisation from other parts of India in a particular Province?—Undoubtedly. You have got both cases in Sind at the present moment. You have got quite a number of Punjabi colonists who come down and settle there, and you have the seasonal migration from Rajputana, the Tharis and Marwaris. They come in every season for cotton picking, make a bit of money and go back again.

A.1526. So that, this matter of the shortage of labour in Sind will solve itself, when the wages of labour go up in Sind?—The wages are comparatively quite good at present.

A.1527. And there is a seasonal migration of labour to obtain those better wages?—Yes.

A.1528. Can you give me concrete instances of agricultural matters in regard to which you wish the Central Government to retain the initiative in its own hands?—Take the case of export crops, the grading of export crops.

A.1529. I was wondering whether you were aware that that was not given over to the Provinces?—I was not aware of it.

A.1530. Can you give me another instance in which you desire the Central Government's initiative?—Livestock work, compilation of Herd books.

A.1531. I want you to be specific about livestock work. What is it that you desire the Central Government to retain?—Take the case of Gir cattle. They are rapidly disappearing. We want records, we want information regarding Gir cattle.

A.1532. Do you not think these are matters which are better left to the Provincial Government concerned?—Where you have got a breed which spreads over a number of Provinces I think it is sounder policy for the Central Government to take it over.

A.1533. *Sir Henry Lawrence:* Does the Gir breed of cattle concern a number of Provinces?—No; that is not a particularly good example.

A.1534. *Dr. Hyder:* What is this disappearance due to, exportation to other parts?—No; not so much exportation as mixture. These breeds must have originated in isolated tracts where there was little communication with the surrounding districts, and when communications improve deterioration sets in in many cases.

A.1535. Would you give any further instance?—Take the red Karachi cattle. That is a breed which has been proved to be suitable for all tropical countries.

A.1536. You think these are matters of sufficient importance for central initiative?—I think so.

A.1537. *Sir Henry Lawrence:* Is the red Karachi breed exported abroad? —Yes, a lot; to Straits Settlements, to Mauritius and so on.

A.1538. Is there any danger of the breed being depleted?—I think there is a danger. One of the recruiting grounds for the red Karachi cattle is outside British India altogether.

A.1539. *Dr. Hyder:* You want Pusa to branch out into the Provinces, that is, you want to have stations in the different Provinces. How are you going to establish connection between these different branches and the Provincial agency working in the Provinces?—That is already being done in the case of Bangalore, and in the case of the sugar station at Coimbatore.

A.1540. You think there is intimate connection between these Imperial stations in the Provinces and the Provincial Departments of Agriculture? —I believe so.

A.1541. Is it a fact that provincial officers do not desire the advice of Pusa because they think, " We are men with the same education, with the same qualifications and further we are men on the spot; we have better knowledge than somebody coming from far off "?—I have not come across much of this feeling. I think the man in the Province, if he is of the opinion that he can get advice on specific subjects at Pusa, has no hesitation in coming to Pusa for advice.

A.1542. To proceed to another matter, the export of bone and oil-cake. Would you make any distinction between these two?—With regard to bones I do not see under the present conditions any great advantage in restricting their export. If we had large supplies of sulphuric acid it would be different. In regard to cake, I do not see that conditions are favourable at present for putting any restriction on the export.

A.1543. But the chemical substances in the case of bones are irreplaceable and in the case of oil-seeds they are replaceable, is not that a serious matter? —I do not think it is a good policy to interfere with the export.

A.1544. You think it is a good thing that the oil-seeds should go to France and other countries and they should not go to parts within the British Empire?—It seems to me it is purely a case of supply and demand. They must follow the market. If you interfere with free trade in things like that the results might be harmful.

A.1545. You do not think you can have these oil-seeds crushed here, export the oil and retain the cake?—That trade is gradually increasing, I think in course of time it will be complete.

A.1546. With regard to bonemeal do you not get it returned to you in the form of sugar from Java? They use it as manure in Java and that gives extra yield of sugarcane and the surplus sugar comes back to India; is not that a serious matter?—The same applies to sulphate of ammonia. It is going to Java too.

A.1547. *Sir Ganga Ram:* Sulphate of ammonia does not go from India? —I think a certain amount of it goes.

A.1548. *Dr. Hyder:* You spoke about rice-hulling machinery. Is that taken up by the small man or by factories?—By merchants.

A.1549. Then with regard to cowdung being used as fuel, how do you think this matter will solve itself if left alone?—It seems to be an extraordinarily difficult thing to deal with and I think the matter has been overdone really. A lot of cowdung is naturally deposited on roads, *bunds* and grazing areas. It is dried up almost at once and people must have fuel.

A.1550. With regard to the drying up of cowdung and its waste, do you not think all these are different manifestations of a very wasteful system of agriculture?—It seems to me that is part and parcel of a wasteful method of grazing. Instead of growing fodder crops cattle are put on to extremely indifferent grazing. Manure is wasted if they are allowed to remain in the grazing ground.

A.1551. To improve the cattle you have got to have them in enclosures, would that be a good thing?—I do not think it is necessary to have them in enclosures.

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A.1552. With regard to the question of marketing of wheat you are familiar with the conditions in Sind and Karachi. Is it true that the trade is against the introduction of elevators on account of the fact that, in unloading, the wheat acquires a little extra moisture and that gives a little extra weight?—I believe that is one of the reasons.

A.1553. *Sir Ganga Ram:* You gave some reasons why the Punjab yield is decreasing. Is it not due to fragmentation and want of consolidation?—I think that is one of the reasons.

A.1554. That is a very important reason. As we go along we find that fragmentation is increasing and consolidation of holdings is necessary?—Yes.

A.1555. Have you any experiments on hydrogenation of oil so as to make it more fit for export and also for its being used as grease for railway wagons?—No; I have not made any experiments.

A.1556. You refer in your note to the dirty wheat of India. Whom do you blame for producing the dirty wheat and for sending the dirty wheat to London?—I do not blame anyone; I merely mention the fact.

A.1557. Do you think the zamindars do it?—They do it a little bit.

A.1558. These exporters do it; I can prove it. I can give you a concrete example. These exporters offered me Rs. 5-8 for my wheat; I did not accept it and the middleman came to me and he paid Rs. 5-12 and then sold it to them for Rs. 5-8 and it was sent to the London market. I have seen it with my own eyes?—I do not deny that a bit, but the wheat as it comes from the zamindar is not clean.

A.1559. I can tell you how it could be avoided. It would be avoided if they gave the rate of pure wheat and quoted the discount afterwards; but they go to the other way; they quote for dirty wheat and it pays the middlemen to make the wheat dirty?—It may be so.

A.1560. In one of the answers you say that you advocate two crops in a year?—Yes, under certain conditions.

A.1561. What two crops?—A fodder crop and a grain crop if possible.

A.1562. Do you know that cotton has a peculiarity of growing on alkaline land?—Yes, it does grow very well on such land in some cases.

A.1563. That is why in Egypt you have succeeded in reclaiming the soil?—Yes.

A.1564. You were on the Committee dealing with the reclamation of barren land?—Yes.

A.1565. Can you tell me whether, if this rank grass and reeds which grow abundantly on the banks of canals were put into silos, it would be fit for cattle to eat during famine or scarcity?—My experience of siloing grasses and coarse fodder is that it does improve them, but you cannot get a first class silage unless you put in a first class raw material.

A.1566. Did you experiment as to converting the rank grass on the banks of canals into edible fodder?—I have seen that done and the result was quite favourable; but it was not a high class silage; it was only fit for starving cattle.

A.1567. But at the present time it is regarded as waste material and is burned. In your opinion would it be desirable to keep it with a view to the possibility of any scarcity of fodder?—Yes, I think it would be a very sound thing.

A.1568. You are aware of the fact that we do not grow sufficient potatoes for the needs of the country?—I think the potato crop is one which requires a considerable amount of investigation; that is one crop that the Imperial Government might take up.

A.1569. That is a very important question?—Yes, it is.

A.1570. At present we are importing from Italy and other countries?—For seed.

A.1571. We also import for consumption. Do potatoes grown from Italian seed give good results?—The seed gives very good results; a certain amount comes to Karachi and a certain amount to Bombay; it is grown near Poona and the seed goes further south to Madras.

A.1572. Are you aware that we do not grow sufficient onions for our own consumption?—I should think that is another promising line of investigation.

A.1573. I know that in the Punjab for 6 months the people eat imported onions, because our potatoes mature in April and if they are kept they begin to shoot after being kept 6 months. Have you made any experiments as to making use of blood from slaughter houses?—No, but it has been done at Poona.

A.1574. For purposes of manure?—Yes, on cane.

A.1575. Is there any literature on that subject?—I think it is mentioned in one of the Poona reports; the work, as far as I remember, was done by Mr. Knight.

A.1576. Because, a very large quantity is exported from Bombay to Hamburg?—Yes. I want to say to Mr. Kamat that when I told him that there were two post-graduate students under training I was wrong; there are three. Post-graduate training at Pusa qualifies a man for the highest posts in the Agricultural Service; but the number of posts for Chemists, Agriculturists, Entomologists, Botanists, etc., does not average one per year for each subject.

A.1577. *Mr. Calvert:* That is, Government posts?—Yes. And that one post when it falls vacant is sometimes given to a local man who has worked his way up. This is done in some cases for political reasons. There are dozens of Indians who have been through Home agricultural colleges and in various parts abroad, and a large number of these men are still on the unemployment list; there is no vacancy for them in Government service.

A.1578. *Sir Thomas Middleton:* That is why you do not have many applicants for training?—That is one of the reasons. There are three and not two post-graduates; one was selected by the Central Provinces Government and sent direct.

A.1579. *Professor Gangulee:* How do you employ these three post-graduate students; what sort of training do you give them?—They come to me for two months to begin with, on the farm.

A.1580. Actually doing the farm work?—Yes. Then they go to the dairy side and do some dairy work; after that they go to the botanical area and Dr. Shaw gives them a course of lectures. They go round all the sections and then come back to me again for final examination.

A.1581. How many post-graduate students have already passed out of your hands?—In all we have turned out somewhere about 80. Some of these of course are not post-graduates. We have trained about 80 in the Agricultural Section.

A.1582. And most of them are employed?—I should think a large number of them are employed.

A.1583. With the equipment and staff your section has, how many post-graduate students would you be able to train per year?—With the present staff and equipment 3 or 4 a year.

A.1584. Do you think this post-graduate training is unpopular?—It is not popular at present because the men who might come here see no prospects in front of them.

A.1585. Would you agree that one way of attracting post-graduate students to Pusa would be to affiliate the Institute to a University and give a degree?—I am really not in a position to answer that. From the agricultural point of view I certainly would not recommend that.

A.1586. Do you supply seed of various crops to different provincial departments?—Yes.

A.1587. And to cultivators?—Yes.

A.1588. Which seeds are in demand?—We supply a very large amount of sugarcane setts and a large weight of oats.

A.1589. Is that the new variety of Scotch oats?—No, we are not giving that out yet; we only give out thoroughly tested varieties. Then the Botanical Section supplies large quantities of wheat.

A.1590. Have you facilities here in the Institute for ascertaining the vitality and purity of seeds which you distribute?—Yes; Dr. Shaw will show you all that to-morrow.

A.1591. I find the total quantity of seed distributed in the year 1922 was 1,775 maunds, whereas in 1923 it was 17 maunds?—That was because cane was brought in, and the returns were not for 12 months.

A.1592. This figure of 17 maunds is only with reference to part of the time?—Yes; the other cane distribution overlapped.

A.1593. You must admit that that figure as it appears without explanation is very confusing?—A note ought to have been added.

A.1594. *Mr. Kamat:* With reference to your visit to Rome in connection with the International Institute there, in your Report you state that although the Government of India have held up, pending the Report of this Royal Commission, the appointment of a permanent delegate on behalf of India to that Institute, you suggest that a temporary delegate should be nominated and sent to Rome. I find from the proceedings of this Board of Agriculture that Mr. Strickland has submitted a note on this very same subject, and he states therein that the delegate on behalf of India should have a knowledge of the French language and preferably of the Italian language as well. Do you agree?—Yes, I think a knowledge of French and Italian would be a very great advantage.

A.1595. He also suggests that the delegate should have an assistant, because single handed he would not be able to do much work, and that it would be a great advantage if the assistant had a knowledge of the German language?—I myself think that is hardly necessary at a preliminary stage.

A.1596. If your proposals to have a temporary delegate sent to Rome were to be accepted, either by this Commission for recommendation to the Government of India, or by the Government of India direct, do you not think it would be an advantage to secure as delegate one who knew both the Italian and German languages?—My personal opinion is that a knowledge of French is essential; a man who knows French, will very soon pick up Italian, especially if he is living in Rome; I do not think he needs to know Italian before he goes to Rome.

A.1597. In the Agricultural Service have you a man who combines the necessary expert knowledge with a knowledge of these one or two languages?—Practically all the members of the Imperial Service are supposed to have a knowledge of French.

A.1598. *Mr. Calvert:* I think you told one of my colleagues that you thought elevators were bound to come?—Yes.

A.1599. Was that remark based on the assumption that the export of wheat would increase?—Yes.

A.1600. At present as you know the tendency to work on the land is more on the decline?—But in view of the very big extension of canals both in the Punjab and in Sind I should think there will be a very big quantity of wheat available for export.

A.1601. But during the last 25 years in spite of the enormous progress and extension that has taken place the results do not bear out that idea. There was no increased export of wheat?—But I am told that there will be a considerable export from Sind alone. Sind at present is not a wheat-eating tract.

A.1602. *The Chairman:* Have you knowledge of Egyptian agriculture in the course of your experience?—Yes, I have a certain amount of experience. I was there for about 3 years.

Mr. G. S. Henderson.

A.1603. Is the Government of India responsible for any research into irrigation problems at this moment?—It is not carrying on any work.

A.1604. Do you think the Government of India might very well make itself responsible for research problems of a fundamental nature?—I think it is very important indeed.

(The witness withdrew.)

Mr. WYNNE SAYER, B.A., Secretary, Sugar Bureau, Pusa.

Replies to the Questionnaire.

Introduction.—I have devoted the last 8 years of my service in India to work on sugarcane both on the cultivation and the manufacturing sides. I have had the privilege of visiting Java and examining at first hand the actual working of the splendid organisation working there for the improvement of the sugar industry and have also recently studied the measures being taken for the development of the beet sugar industry in England. In my replies to the Questionnaire, I will therefore confine myself principally to the measures to be taken for the development of the Indian sugarcane industry in respect of both *gur* and sugar manufacture.

Question 1.—(*a*) I consider it essential that all work on cane should be pooled and carried on under a small committee whose composition is given in Appendix I. We should then have the local knowledge of all workers in the Provinces and the technical experience of the specialist staff available for any problem which might come up. As cane does not respect provincial boundaries it is frequently the case that an improvement introduced into one Province is suitable for a tract in another Province. A committee of the type proposed by me will be able to correlate the work, make accumulated experience available to the Provinces and prevent any unnecessary overlapping. Sugarcane being a crop which is under cultivation in almost all the Provinces of India, it is in the fitness of things that the Government of India should supplement the efforts being made in the Provinces by providing for research and experiment which will be of benefit to all Provinces and which is beyond the means of any single Province either to initiate or to maintain.

Further, India has annually between two millions and a half and three million acres under cane (statistics for last 5 years given in Appendix II). India's imports of sugar from abroad are nearly 720,000 tons valued at roughly 15 crores of rupees (last five years' figures as compared with 1913-14 given in Appendix III) and as the Government of India levy an important duty yielding a revenue of about 5 crores which falls as an indirect tax on the consumers, the industry as well as the general public naturally expect that they shall not continue to be taxed indefinitely for an essential article of food like sugar when with adequate provision for research and experiment and propaganda the country itself can meet its own requirements and can thus put an end to the drain of 15 crores of rupees a year now spent on foreign sugar.

I am convinced that if Java can manufacture two million tons of sugar off an area of 425,000 acres it will not be impossible to raise 800,000 tons of sugar from an equal area devoted to cane in the eastern portion of the United Provinces and Bihar alone, leaving the remaining 2 millions and odd acres annually for *gur* making. It is a matter of profound regret that the Government of India have not been able to carry out any of the major recommendations of the Indian Sugar Committee appointed in 1919 and now that it does not appear within the range of practical politics that they will carry them out in the near future, I venture to suggest that the Government of India should, besides providing for permanence and continuity of the work being done by the Sugar Bureau at Pusa and by the Cane Breeding Station at Coimbatore, establish two Imperial stations, one in the western portion of the United Provinces bordering on the Punjab and another in the canal tracts of the Deccan. Temporary stations in addition may be opened in other important cane tracts in consultation with the Provincial Departments of Agriculture when it is considered advisable to do so in the interests of the industry.

I do not think any Province will ever staff itself sufficiently to have workers on every crop and on all points connected with it. Certain crops and problems must go to the wall for lack of workers and it is here the Imperial

Government can step in to fill the gap. Deputy Directors in the Provinces have to work on a variety of crops and cannot therefore be expected to possess that detailed knowledge and experience which a crop like sugarcane requires and which can only be obtained by (1) visits to Provinces or central stations which are more advanced in their work on cane and (2) by keeping themselves uptodate with the literature emanating from the most progressive sugar-growing countries. Hence the necessity of entertaining a whole-time special cane staff to provide that expert knowledge to assist workers in the Provinces, many of whom may not have been outside their own Province or tract. It is not intended that there should be any control exercised by the Imperial staff over the staff in the Provinces. The object in view is to develop the sugarcane work in the Provinces in close co-operation with the local authorities and not to interfere in any way with their work nor to supersede any of the activities of the local department.

Problems such as the best type of bullock driven 2 roller and 3 roller mills, 5 roller power driven mills, methods of *gur* boiling, better types of furnaces are common to all Provinces. The same is the case with various questions relating to white sugar manufacture. The question of high class technical training in sugar manufacture can also be solved for all Provinces, if the Government of India accept the modest scheme outlined in the appendix.

(*b*) Lack of a Sugar Technologist and a Sugar Engineer has considerably handicapped our research work on manufacturing problems and on all problems connected with improved sugarcane mills and furnaces.

Lack of a suitable farm for proper cultural and manurial tests and for working out various problems connected with the growing of sugarcane, which would have been of great value to the established white sugar industry and to some Provinces.

Question 3.—(*a*) From my close acquaintance with the conditions obtaining in this part of Northern India I can say that the presence of a small progressive agricultural class is a great asset as it forms a very useful medium for demonstrating and introducing agricultural improvements. This is well shown by the readiness with which progressive planters in North Bihar have taken up the superior varieties of Coimbatore canes recommended by the Sugar Bureau.

When zamindars take an interest and grow these superior canes on their own home-farms, the success of the crop is at once noticed by their tenants who are also cane growers on a small scale and the improvement, if within their means, is taken up by the cultivators with no further trouble to anyone. I therefore consider that in tracts where the zamindari system of land tenure prevails the first thing to do is to enlist the sympathy and the interest of the zamindar and to arrange for demonstration on his land of any agricultural improvements that are proposed to be introduced.

(*b*) Field demonstrations should be limited to doing certain work on a certain crop under guidance. It should as far as possible be started by one's own skilled men and then continued by the cultivators' or growers' men. What a man has done himself he believes in.

(*c*) Cultivators will be induced to adopt expert advice if (1) the improvement is really such that it does not require capital beyond their means to borrow and (2) the improvement will repay them not only for the high rate of interest that they have to pay to the *mahajan*, but for the extra trouble that they have to take and (3) the adoption of the improvement does not entail any far-reaching change in their agricultural routine and (4) the improvements are brought to their notice by the trained staff who can enter into their thoughts and feelings and can talk to them in a language which they can understand. As for example, it is no use recommending a heavy plough, no matter how good work it does, in a district where the local bullocks cannot draw it or where no facilities are available for repairs if the plough is broken or is otherwise out of order.

(*d*) The success which the Sugar Bureau has achieved in introducing superior varieties of Coimbatore canes within the last five years was brought about in the following way. First, four canes were selected out and large scale tests were carried out on land which was not considered good land by local cane growers, with implements and manures within the reach of ordinary growers. Growers were invited to see the crop whenever they liked and to watch the cultivation and manuring and finally the cane was put through the mill with a view to obtain complete data regarding the superiority of the new selected canes over the local variety not only from the growers' point of view but also from that of the factory. The cane was cut, handled, loaded and sent to mill exactly as an ordinary grower's crop would be dealt with. The growers were thus able to see that no operation was beyond their own powers and when they were satisfied on this point large scale distribution was undertaken. By constant touring I kept in close touch with the growers who were helped with advice. No attempts were made at first to convince the small ryot direct.

Things were first explained to the educated growers, the crop succeeded with them and from there worked its way into district practice, and then it filtered down automatically to the small ryots who are taking up these canes in ever increasing numbers. The reason for success was that we never asked anyone to take a risk. My experience is that no real improvement worth the name either in cane varieties or cultivation methods fails to catch on if it has been worked out on knowledge of the actual agricultural practice of the district.

Cultivators are sceptical of any success on a Government farm as they suspect that the large Government staff, costly implements and facilities for doing everything at the right time regardless of cost are the main factors contributing to the success and they know that they possess no such facilities.

We made no attempt to force miraculous yields for personal advertisement. Growers copied our methods and soon obtained confidence when they found in many cases they could do better than we had done. Failure to approximate to Government crop yields is in my opinion the chief cause of suspicion of Government farm methods.

Question 4.—(*a*) So far as the sugarcane crop is concerned, I consider co-ordination of the activities now being conducted by the provincial departments and the central department extremely desirable and a committee of the kind proposed by me will be able to achieve this object (Appendix I). I am of the opinion that an organisation of the type of the present Board of Agriculture should be continued to enable scientific workers to meet together, to exchange ideas, to compare each other's experiences and to discuss programmes of work. This will break down the isolation of the workers in the Provinces and be to the good of all. This body should however have nothing to do with administrative questions or questions of policy.

(*b*) I consider that for crops like sugarcane, wheat, tobacco and rice which are common to more Provinces than one it is desirable that the central department should have a strong staff of specialists whose wider knowledge and experience can be drawn upon by the Provinces and when an urgent or serious problem arises in any Province in connection with these crops, their services should be made available to the Province in a spirit of co-operation. These specialists of the central department should have no authority whatsoever over the officers of the local department nor should they be allowed to criticise or pass any remarks on the work of an officer in a Province unless the local Director of Agriculture desires them to do so.

(*c*) Since the institution of the Reforms the Agricultural Departments are devoting increasing attention to the propaganda and demonstration side and are thus becoming more and more known to actual cultivators. But I would also like more work to be done on the research side as research is the foundation of all demonstration in that it provides material for demonstration. When the obvious improvements which have not required long detailed scientific investigation have been taken up by cultivators, the departments should have other improvements ready to hand for propagation among the agriculturists. I also consider that a liaison officer should exist to work between the research side and the demonstration side in each crop.

(*c*) (*ii*) Speaking of the part in which my main activities lie I may say that on the metre gauge lines the train service so far as passenger traffic is concerned is so slow that I calculate some weeks of my active service have been wasted on their system in journeys. The railway company in the white sugar tract tries to meet the requirements of cane factories by running special cane trains, but the trucks are not of a good pattern or modern. Several branch lines can be opened in Gorakhpur district and in North Bihar which will pass through the cane area and while being successful from a revenue point of view will help the white sugar industry by providing cheap and quick transport of cane to sugar factories in this tract.

In Assam in the Brahmaputra Valley where good thick cane can be grown, it is the absence of railways and good *pucca* roads and bridges that is hampering the development of the tract. One factory that was put up there had to be closed down and another proposition had to be held over for want of proper communications in that part.

QUESTION 5.—(*a*) Sugarcane is a crop which requires considerable capital (the cost of cultivation ranging from Rs. 75 per acre in Bihar to Rs. 650 in the Deccan canal irrigated areas). Wherever possible, arrangements should be made through co-operative credit societies to finance sugarcane growers to enable them to obtain healthy seedcane of approved varieties and to purchase oil-cakes and artificial manures. To enable them to purchase good cane crushing mills, loans should be made by co-operative institutions providing such credit. Development of healthy, energetic, really useful co-operative societies in the white sugar tract in Northern India is a great desideratum and the sooner some vigorous action is taken in this line, the better for the sugarcane cultivators, the sugar industry and for the country as a whole, since with increased production of cane as the result of better manuring and improved cultivation and better appliances for crushing the cane the sum total of India's wealth will increase.

QUESTION 7.—(*a*) The development of the sugar industry in India has been considerably handicapped by the excessively small holdings of cultivators. It is not possible to obtain in one continuous block a sufficiently large area to meet the needs of a sugar factory.

QUESTION 8.—(*a*) I consider that in the white sugar tract in North India, there is room for providing irrigation supplies from rivers. I have found from experience that three irrigations given to the cane crop in the hot weather in this part make a considerable difference to the yield of the crop. In all cases before introducing irrigation schemes agricultural experts should be consulted and all such schemes should be properly designed. I am also of the opinion that the setting up of pumping installations in the white sugar tract on the banks of rivers and streams which do not dry up in the hot weather requires to be closely studied as, at present, much of the water in these rivers remains unutilised.

QUESTION 10.—(*a*) In my opinion India should make greater use of the various oil-cakes, fish manure and sulphate of ammonia produced within the country. For the sugarcane crop which requires from 75 to 150 lbs. of nitrogen per acre special manure depôts should be opened by the Co-operative Department in those tracts where *gur* making is the rule, and by sugar factories where they obtain their supplies from guaranteed growers of cane. Co-operative manure depôts should buy and hold manures as the rise in the price of oil-cake is very marked at the commencement of the planting season. As in Formosa, sugar factories should undertake to distribute artificial fertilisers to the cane suppliers and recover the actual cost *plus* a small rate of interest at the time the cultivator brings his cane to the factory.

(In Formosa companies now give manure free instead of paying bonuses to growers. This method might ultimately be introduced.)

I have always recommended the use of sulphate of ammonia, nitrate of soda, castor and other cakes among sugarcane growers in the white sugar tract and as a result of my efforts the British Sulphate of Ammonia Federation Ltd., have opened a depôt at Muzaffarpur and I am now endeavouring to get the Chilean Nitrate Committee to do likewise. I have also induced some of the factories to demonstrate the advantages of applying sulphate of ammonia and nitrate of soda on the cultivators' own lands and these, when found successful, are sure to be copied by other cultivators in the neighbourhood.

From experiments I have found that nitrate of soda is a good manure for forcing the cane crop for seed and sulphate of ammonia a good manure as a top dressing and the use of these fertilisers is increasing.

Question 12.—(*i*) In this part of India where cane is grown without irrigation, deeper ploughing is to be recommended so that the cane setts may have sufficient moisture for germination and the cane crop may be better able to withstand high winds. The present implements do not ensure this deep ploughing and a satisfactory improvement on the *deshi* plough requires to be more generally adopted.

(*ii*) Cane should not be planted on the same land at short intervals as it is an exhausting crop. The suitable rotation for cane in this part is as under:—

(1) Cane—1st year.
(2) Maize in the rains. }
(3) Oats in rabi. } 2nd year.
(4) Green crop in the rains to be turned in. }
(5) Fallow in rabi. } 3rd year.
(6) Cane again—4th year.

As the soil in this part of India is said to be deficient in phosphoric acid, an application of superphosphate at the time of turning in the green crop is very desirable.

Question 13.—(*i*) Under the Government of India's Destructive Insects and Pests' Act, the importation of cane from countries having serious fungus diseases or insects pests is altogether prohibited or allowed under certain safeguards. Within the country there is no co-operation among cane growers as they are not aware of the causes which spread fungoid and insect pests. Selection of setts before planting so as to reject diseased material or canes which have been attacked by borers is not general and the Sugar Bureau is advocating sett selection. Red rot and mosaic are among the principal diseases and much useful work can be done by itinerant staff under the guidance of specialists in crop diseases.

White ants and borers do a considerable amount of damage. A special Entomologist to study these pests and to devise practical measures of control is an urgent necessity. More propagandist staff is also required to bring home to cultivators the enormous loss they suffer from the neglect of ordinary precautions in the case of those diseases and insect pests which have already been sufficiently studied.

Question 14.—Foreign implements are costly and in villages where facilities for repairs are non-existent, they should not ordinarily be recommended. In my opinion, improvements in implements should be on the lines of making the desired alterations in the existing ones. The implements should not be heavy, otherwise the draught cattle will not be able to pull them. The price also should be well within the means of cultivators. Tractors are good enough for fairly large growers but as the majority are small cultivators, work should be concentrated on meeting their requirements. Horse hoes are very useful for intertillage and do the work cheaply as compared with manual labour and the Sugar Bureau is advocating their use.

Question 16.—(*e*) Here I hold strong views. The backbone of India is agriculture. To make it popular among the zamindars and higher classes it must be made fashionable.

Mr. Wynne Sayer.

The strength of English agriculture lies in the fact that every person of real importance in England from the King downwards is a farmer and is interested in farming and stock. The same cannot be said at present in India. The obvious method of making agriculture popular is to use the Honours List to this end. Every year honours are given for all manner of things to all kinds of people. Rarely if ever are they given to a man because he is doing his best to improve his land and the conditions of his tenantry or the agriculture of his estate. In short, rarely are they given for the one thing which is the foundation of India.

I think we should begin at the top. If the Viceroy had a farm for high class cattle and exhibited them, grew decent crops and helped to show that he was directly interested, it would give a direct fillip. Indian States would show remarkable improvement if guns and seed farms were correlated. Until it is definitely shown by some such means that the highest in the land are interested, I am convinced the landlords and upper classes will maintain their present attitude of practical indifference.

I am also of opinion that the failure in so many cases of zamindars and the landed classes to realise the obligations to their tenantry that their position entails is holding back agricultural development. A zamindar can assist his tenantry and improve conditions on his estates to a considerable degree if only it can be brought home to him that it is his duty as a landlord.

QUESTION 17.—(*e*) Sugar-making can be carried on only in large size factories. As these factories will have to be located in the cane district in order to be successful they will provide a subsidiary source of income to families having idle labour. There is room for a large number of factories in Northern India but they cannot be put up so long as sufficient inducement is not offered to capitalists by guaranteeing them against loss in the first ten years of the existence of the factory. Other countries as far ahead and we are wanting in skilled men and technical experience.

Gur-making which is a subsidiary industry so far as agriculturists are concerned is wasteful as conducted at present. The Indian ryot combines the functions of both producer of raw material and manufacturer of a finished product and on account of his inefficiency loses a great portion of his profits. *Gur*-making is therefore not to be recommended as a subsidiary means of employment. Only such occupations as are best done by hand labour and which do not require skilled supervision of an order not possessed by an agriculturist should be considered as worthy of recommendation.

QUESTION 20.—(*a*), (*b*), and (*c*) The sugarcane crop is worked up into two principal products, *gur* and sugar. *Gur* is of two qualities, (1) for direct human consumption and (2) the inferior grade fit only for refining. As regards good *gur*, the cultivator sells it to a middleman or sells it through a broker. The ignorant cultivator is very often cheated both in weighment and in price offered. Very often he has taken an advance of the money to enable him to grow the crop and he cannot hold his *gur* for a rise in the market nor risk keeping it through the rains. Co-operative *gur* sale societies can do a lot of good here. I will give an example. In the Nira Canal area of the Deccan, where high class eating *gur* is manufactured, the cultivators were not receiving the proper price when selling through brokers in Baramati. It was when a co-operative *gur* depôt was opened by the Bombay Central Co-operative Bank and when regular auctions were instituted which were widely advertised that the cultivators began to get the real value for their product and the depôt has been a great success. Work on similar lines might be instituted in important *gur* centres like Anakapalle, Meerut, etc. Where inferior *gur* is sold for refining, the competition of several refineries which are now working ensures a reasonable price in large centres like Siswa Bazar and Ghughli. But what I would like to see is some arrangement to enable the ryots to hold up their produce when the market is rising so as to sell it to the best advantage. At present they undoubtedly sacrifice most of their profit to the middleman.

Mr. Wynne Sayer.

As regards white sugar manufactured by Indian factories, this sugar ranks with 24 D. S. and the chief markets are Cawnpore and Amritsar. All sugar is sold f. o. r. Cawnpore. This sugar is mostly consumed in Rajputana and Central India and the Punjab. In Java and Mauritius it is an association or syndicate of 90 per cent of the mills that effects the sale and not each factory individually. Here there is no such united organisation, and factories having limited godown space are obliged to dispose of their sugar as soon as they can for financial and other reasons. The Commission will get useful information on this point from the Indian Sugar Producers' Association, Cawnpore.

As regards *deshi* sugar manufactured from date palm in Bengal, the price of which is artificial as it is based not on sucrose value but on caste prejudice, the principal market is Calcutta where Hindu merchants, Marwaris and orthodox people, buy it. *Dobora* date sugar was selling at Rs. 25 and Rs. 22 per maund in the 1st week of February and March, 1925, when Java sugar was selling at Rs. 12-7 and Rs. 12-5 per maund.

As regards sugar made by *khandsaries* in the United Provinces, the price as in the above case is purely based on religious sentiment and it sells in local markets at a price much above its intrinsic value. The price of *deshi* sugar in Cawnpore in the last week of March, 1925, was Rs. 25 to Rs. 26 per maund when Java sugar was selling in the same market for Rs. 13-8 per maund. In the last week of March, 1926, while Java white sugar was selling in Cawnpore at Rs. 12-6, *deshi* sugar was selling at Rs. 18 to Rs. 23 per maund.

(*d*) As the importers of foreign sugar into India and manufacturers of white sugar in India were found to be not adequately informed regarding the state of the sugar crop in the world, the total supplies available, world's consumption and factors affecting production and consumption in any single year, I instituted a system of getting by cable reports regarding the condition of the world's crops and price quotations from important sugar markets such as New York, London, and Soerabaya and supplementing these by weekly market reviews and statistics likely to be useful to those dealing in sugar. Members from Bombay, Calcutta, Karachi, Cawnpore, Madras readily joined and they have found the service of great benefit to them. The whole cost is borne by the members who participate in the scheme. Consumers are also benefited as undue fluctuations in prices based on wild rumours are effectively squashed by this means. The popularity of this service has led two private agencies to greatly improve the nature of their news supply and as private enterprise is always able to do things better and more cheaply than a State department bound down by rules and regulations, the present service having done the work of a pioneer in this line, it may ultimately be unnecessary for the Sugar Bureau to continue it.

I think similar cable services can usefully be started for crops like wheat and oil-seeds. In fact I was asked by several merchants in Karachi during my last visit to start such a service and I had to inform them that my time was fully occupied with sugar. I referred them to the Government of India in the Commerce Department.

QUESTION 21.—The existing customs duty on imported sugar is Rs. 4-8 per cwt. of sugar 23 D. S. and above and Rs. 4 per cwt. of sugar 22 D. S. and below. The duty is avowedly for revenue purposes, the Government not having committed themselves to any statement that they were going to protect sugar in this way. Sugar manufactured by modern factories and refineries in India is not exported in any appreciable quantity as the production is hardly 100,000 tons which is not sufficient for India's requirements. The existing import duties do not adversely affect the interests of the cultivators as without such duties the *gur* industry would be severely threatened by cheap Java sugar. As sugar was selling at Rs. 38 per maund in August, 1920, the consumers have no reasonable complaint to make regarding the burden of this duty as the price has fallen to Rs. 13 per maund and the consumers of foreign refined sugar are those upper and middle classes who can afford it. Further, the imports of sugar are steadily rising which proves ready consumption.

QUESTION 23.—I believe that the spread of primary education in rural areas, however defective it may be, will be to the good of the community, as a knowledge of arithmetic however slight and the capacity to read and write will prevent the ryots of the future being cheated and defrauded in weights, measures, prices, payments for interest, etc. That in itself will lead to an amelioration of their condition to some extend.

APPENDIX I.

I propose that in view of the importance of the sugarcane crop in the rural economy of India and the heavy imports of over 700,000 tons of foreign sugar valued at roughly 15 crores of rupees, which imports can be met from the increased production in the country if well directed and sustained efforts are made to improve the industry, the work on the sugarcane crop and sugar manufacture should be placed on a proper and permanent footing. As the Government of India have hitherto been unable to carry out the major recommendations of the Indian Sugar Committee and it does not seem likely that they will be able to find funds for those recommendations in the near future I am submitting these comparatively modest proposals to ensure that (1) the interests of small cane cultivators as regards improved varieties, proper manuring, right type of cane mills suitable for their requirements, improved furnaces and pans may be met, (2) the interests of the white sugar manufacturing industry may be looked after and (3) the required provision for a high grade technical education in sugar manufacture may be made in this country.

Besides maintaining and making permanent the work being done by the Sugar Bureau at Pusa and the Cane Breeding Station at Coimbatore, it is necessary to provide immediately one Imperial farm on the western border of the United Provinces and the eastern portion of the Punjab somewhere near Karnal or Meerut, and one in the canal-irrigated tracts of the Deccan. These farms should each be of roughly 200 acres. Here improved varieties from Coimbatore and abroad will be tested, the proper system of planting cane, manurial treatment, water requirements, etc., will be studied. The cost of acquisition of land may be placed at 1 lakh in each case; buildings including residences for staff Rs. 1,50,000 and equipment Rs. 50,000 for the two farms. Thus the non-recurring charge on account of these two farms will be Rs. 4 lakhs.

The recurring charge may be placed at Rs. 12,500 for each farm exclusive of the cost in respect of pay of the subordinate staff which will be another Rs. 7,500 per annum or Rs. 40,000 in all for the two farms. Both these farms will be supervised by the Secretary, Sugar Bureau. These farms will provide facilities to the Government Sugarcane Expert to make observations on the behaviour of his canes, etc., which he at present lacks. There should be a Technologist attached to the Bureau whose salary will cost, say, Rs. 30,000 a year (Rs. 15,000 will be required for fittings for his laboratory, a non-recurring grant), the cost of a Head Chemist under him and the establishment may be put down at Rs. 10,000 a year while Rs. 5,000 a year will do for contingencies. A Sugar Engineer is also urgently required, the annual cost of whose salary will be Rs. 15,000, Rs. 10,000 may be provided for his staff and establishment (and Rs. 20,000 for plant, etc., a non-recurring grant) and Rs. 5,000 for miscellaneous expenses.

A Sugar Boiler or Factory Operator should also be recruited to work the small sugar factory mentioned below. His annual salary will be Rs. 12,000; his subordinate and technical staff, etc., will cost annually Rs. 10,000. For contingencies we may provide Rs. 5,000. There should be a small model factory attached to one of these farms and it may be estimated to cost £10,000 (it can be entirely manufactured in India). The annual recurring charge in connection with this factory may be estimated at Rs. 15,000. Cane for the factory will be provided by the farm. The Technologist, the Engineer and the Factory Operator will conduct their experiments in this factory. When these experts are recruited, high class technical education in sugar manufacture can be started which will supply a long felt want in India.

Apart from problems worked out in the factory these experts will study the various problems connected with *gur* manufacture, cane-crushing in small bullock driven mills, small power-driven mills, improved furnaces and the right type of pans.

Mr. Wynne Sayer.

All this work should be under the control of an All-India Committee constituted as under:

The Agricultural Adviser to the Government of India.

The Government Sugarcane Expert.

Director of Agriculture of each Province or an officer deputed by each Province in his stead.

The Secretary, Sugar Bureau (*ex-officio* Secretary).

Representative of the manufacturing industry.

Non-official interested in sugarcane growing.

Member of the trade.

This Committee will meet at least twice a year to examine the work done and in progress and lay down lines of work. The cost of the travelling allowance and incidental expenses may be put down at Rs. 15,000 a year. This body will control expenditure and be directly under the Government of India. Its function as regards the Provinces will be on the same lines as those of the Indian Cotton Committee.

The cost of my proposals is as follows:—

Recurring.

	Rs.
Sugar Bureau	45,000
Coimbatore Breeding Station	70,000
2 Farms	40,000
1 Model factory working expenses	15,000
1 Technologist	30,000
Staff	10,000
Contingencies	5,000
Sugar Engineer	15,000
Staff	10,000
Miscellaneous	5,000
Sugar Boiler	12,000
Staff	10,000
Contingencies	5,000
Meetings of the Sugar Committee	15,000
	2,87,000

Non-recurring.

	Rs.
Model factory	1,50,000
Plant for Sugar Engineer	20,000
Cost of land for two farms	2,00,000
Buildings on farms and residences	1,50,000
Equipment for farms	50,000
Laboratory for the Technologist	15,000
	5,85,000

A capital cost of less than Rs. 6 lakhs is not at all a formidable figure for the Government of India; while against the recurring cost of less than Rs. 3 lakhs, a net revenue of not less than Rs. 50,000 may be anticipated, as fees will be charged to students undergoing training and for visits paid by experts to private factories at the request of the management concerned. As the Government of India already spend over a lakh of rupees annually on the Coimbatore Cane Breeding Station and the Sugar Bureau at Pusa, the net extra recurring cost involved is only Rs. 1¼ lakhs a year which can well be incurred by the Government as cane is a crop which is in most Provinces difficult to replace if it proves unremunerative.

Mr. Wynne Sayer.

APPENDIX II.

Area (in acres) under Sugarcane cultivation in India during the last five years.

No.	Province.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	REMARKS.
1	United Provinces including Indian States.	1,162,000	1,359,000	1,554,000	1,303,000	1,408,000	
2	Punjab	378,000	497,000	483,000	396,000	389,000	
3	Bihar and Orissa	306,000	306,000	307,000	289,000	294,000	
	Chota Nagpur and Orissa Feudatory States.	15,000	15,000	20,000	20,000	14,000	
4	Bengal	221,000	201,000	202,000	206,000	215,000	
5	Madras	119,000	131,000	121,000	110,000	114,000	
6	Bombay and Sind including Indian States.	81,000	96,000	101,000	84,000	75,000	
7	Assam	41,000	42,000	42,000	42,000	41,000	

8	North-West Frontier Province .	34,000	39,000	43,000	41,000	48,000	
9	Central Provinces and Berar . .	17,000	19,000	22,000	22,000	23,000	
10	Delhi	7,000	9,000	8,000	5,000	8,000	
11	Mysore	32,000	38,000	54,000	32,000	32,000	
12	Baroda	2,000	3,000	3,000	2,000	1,000	
13	Burma, Ajmer, Marwar and Coorg .	20,000	25,000	165,000	165,000	*158,000	*Provisional.
14	Hyderabad State	31,623	33,370				
15	Gwalior State	10,330	8,846				
16	Kashmir	6,166	6,560				
17	Madras	19,350	6,990				
18	Central India	6,634	6,387				
19	Rajputana	6,350	5,376				
20	Punjab	41,254	56,794				
	GRAND TOTAL .	2,551,707	2,904,323	3,105,000	2,717,000	*2,820,000	

APPENDIX III.

Quantity and Value of Sugar 16 D. S. and above and 15 D. S. and below imported into British India during the pre-war year 1913-14 and last 5 years 1921-22 to 1925-26.

Year.	Gross Import.		Re-export.		Net Imports.	
	Tons.	Rs.	Tons.	Rs.	Tons.	Rs.
1913-14	803,000	14,28,85,185	9,700	20,74,048	793,300	14,08,11,137
1921-22	717,642	26,77,88,258	32,621	1,70,44,226	685,021	25,07,44,032
1922-23	442,376	14,84,76,955	62,962	2,62,35,348	379,414	12,22,41,607
1923-24	411,500	14,78,06,539	35,800	1,60,67,201	375,700	13,17,39,338
1924-25	670,965	20,36,89,515	21,990	91,49,450	648,975	19,45,40,065
1925-26	738,224	15,20,30,278	16,393	50,12,362	721,831	14,70,17,916

Oral Evidence.

A.1605. *The Chairman:* Mr. Sayer, you are Secretary of the Sugar Bureau?—Yes.

A.1606. You have provided the Commission with a note of the evidence that you wish to give. Do you wish to make any statement of a general character at this stage?—No.

A.1607. Would you give the Commission a short account of your own training and past appointments?—I came out here as Assistant to the Agricultural Adviser in 1914. I held that post until 1919 when I was appointed Secretary, Sugar Bureau. After that I was on the Sugar Committee as a Member during 1919-20 and then I reverted as Secretary, Sugar Bureau, which post I am at present holding.

A.1608. What is your view about the suitability of the site at Pusa for this station?—Admirable.

A.1609. Do you think that the comparative inaccessibility of the district is really any bar?—The industry is here and there is no bar at all, and therefore the inaccessibility does not have to be got over.

A.1610. That is so far as sugar is concerned?—Yes.

A.1611. Are you satisfied with the internal organisation at Pusa?—As regards the sugar work?

A.1612. In regard to sugar work, and also we should like to hear any views you may have on the organisation of other branches?—No, I am not. We have been left on a temporary basis for now 8 years. I think that it is high time that something should be done. It is neither fair to the work nor to the men working on it to be left on a temporary basis for this length of time.

A.1613. When you say 'we,' do you mean the Sugar Bureau?—Yes. I also refer to the Coimbatore Station which has only just been made permanent.

A.1614. Are you satisfied with the arrangements according to which the breeding of sugarcane is carried on at Coimbatore while the head and centre of the organisation is here?—Yes. The breeding must go on at Coimbatore; you cannot take it anywhere else, and the head and centre of the organisation must be where the industry is because in my opinion the ultimate end of *gur* will be white sugar and this will be the centre of it all.

A.1615. How about your touch with the Provinces? Are you satisfied with that?—Quite; there are no difficulties at all.

A.1616. Has anything been done for the sugar industry in Madras?—We have just appointed a thick cane expert. I do not know whether he will be able to do very much for Madras where exotic canes can be imported from other places like Hawaii. My own impression is that the man should have been recruited from a place like Hawaii where they have had experience of the thick cane industry and he then would have brought valuable knowledge and experience to bear on the subject; whereas we have taken a comparatively raw man with no knowledge outside India and we have considerably crippled the industry.

A.1617. Have you yourself ever been to Java?—Yes, I went as a member of the Sugar Committee.

A.1618. Do you think that was of advantage to you in your present position?—Distinctly. I also think the Government Sugarcane Expert should be sent and further that every man who has much to do with sugar should get a chance of seeing a highly developed industry like that.

A.1619. Had you difficulty in getting permission and the necessary financial provision for these journeys?—The Government of India at first disapproved of my suggestion that the Committee should go to Java, but it was urged on them and they gave way and we were allowed to go.

A.1620. Are you satisfied, on the whole, with the achievements of your section in popularising improved varieties of cane?—I think considering the small staff we have and the fact that being on a temporary basis we have no possible means of retaining that staff we have done the utmost that is possible.

A.1621. Have you had any set-backs? By set-backs I mean other districts having once adopted your improved varieties and then discarding them? —None.

A.1622. Are the outlooks respectively of the grower and the factory in line at this moment?—No, I do not think they ever will be.

A.1623. Will you describe the difficulty?—The difficulty is due to the fact that so long as the factory and the grower are both independent units the grower naturally leans towards the heaviest quality of cane that he can grow because he is paid on the maundage basis. In a country like India where the ordinary grower is an uneducated man you cannot possibly pay him on a sucrose basis as is done in other countries.

A.1624. Why is it not possible to pay the grower on a sucrose basis?—Because, he is not able to understand even now the weights and measures at the railway stations. If he only understood the difference and were paid on the sucrose basis he would be all right, otherwise there is the danger of cheating. But the grower can be given a premium as is done by one group of factories for better quality canes having more sucrose.

A.1625. It is a good point for primary education?—Yes. The mill wants the highest possible amount of sugar from the cane. But the grower is naturally on the look out for an increased tonnage and therefore I have to constantly keep my eyes open to see that no bad cane creeps into the independent cultivation here; that would be a disaster from the mill point of view if it were generally grown.

A.1626. The difference in yield per acre in India on the average as compared with the yield per acre in some other countries is very striking, is it not?—Yes.

A.1627. Is it due to any inherent defects in the soil or climate of India?—It is due to the fact that the cane industry of India is concentrated in a subtropical part and is not a specialised industry. In those countries where you get enormous yields cane is grown in a tropical climate and is a specialised cultivated crop grown on modern methods, by proper manuring and proper scientific treatment.

A.1628. In your view there is no reason why the yield in India should not be as high as it is in other countries?—I think we have proved in this district that the present yields can be considerably improved.

A.1629. Does that answer apply both to wet and dry cultivation?—So far our chief work has been done on unirrigated land. My experience however is that once you have had the experience of unirrigated land, and then you apply it to irrigated land you could get a tremendous increase in yield.

A.1630. You said that in your view the present market for *gur* in India will ultimately develop into a white sugar market?—Yes.

A.1631. Is the *gur* market at the moment a stable and fixed market or is it liable to give way to sugar when the price of *gur* is higher in proportion to sugar?—As far as I am able to see, there is no connection whatever between them. I have a series of charts with me in my office which, if I had only had the time this morning to show you, would have convinced you of my opinion. From those charts you will see that when the price of sugar goes up that of *gur* does not necessarily rise in the same proportion but in some cases shows a fall.

A.1632. Does the consumption not tend to rise in *gur* and to fall at the same time in the case of sugar?—No, the consumption is not necessarily checked in that manner. When *gur* is cheap and plentiful, it has some effect on consumption of sugar but it is not appreciable. The *gur* market is purely a local market. The difference in prices in various places is such that I myself think that with proper organisation *gur* could be produced and sold at a profit.

A.1633. From your own experience do you think the *gur* market will develop into a sugar market?—Communications are improving everywhere in India, and nearly everybody has started to drink tea. The result is that cheap sugar can be got everywhere now. The consumption of white sugar is steadily increasing and it does not appear to me that *gur*, which is already based on a price which is far above the sucrose ratio, can carry on. It will ultimately be replaced by white sugar. I have now enquired whether it would be possible to take white sugar and molasses and make *gur*, and whether the component parts of *gur* could be bought from the outside market, and we are awaiting the result of the experiment.

A.1634. Now, coming to your note. Would you like to see the full recommendations of the Sugar Committee put into force?—I should like the chief recommendations put into force. But it should be remembered that they were based on rather too high a financial cost; they were too expensive.

A.1635. You think that good results can be obtained with less money?—Yes. I have put up a note embodying my suggestions.

A.1636. I only wanted to give you the opportunity of traversing any of the recommendations of the Sugar Committee if you wished to do so?—I have dealt with the matter in my note.

A.1637. On page 172 you are talking about certain failures to persuade the cultivators to adopt the improved varieties of cane. What failures have you in your view which go to show that Government crop yields have been so far above anything that the ryot could achieve, that disappointment has resulted and confidence has been lost? Do you suggest that in demonstrating improved cane the demonstration should be carried out on the scale and with the means available for the ryot; is that the idea?—I consider that the demonstration should be carried out first of all on the fields of a man who is a fairly big grower. To begin with, we should not go near the actual ryot. The demonstration should be done on the field of a man who is a fairly good cultivator and it should be done with the implements that he can use. We used to plant half the cane and then make his men and his bullocks do the rest. Then he was convinced that it was perfectly possible for him to do it.

A.1638. I misunderstood your note. I see what you mean is that the cultivator has adopted the crop and through faulty cultivation has not attained good results?—If you go straight to the cultivator, my impression is that he becomes suspicious. He will copy from his next door neighbour far more readily than he will copy from you directly.

A.1639. On page 173 you suggest that in India, as in Formosa, "sugar factories should undertake to distribute artificial fertilisers to the cane suppliers and recover the actual cost *plus* a small rate of interest at the time the cultivator brings his cane to the factory." Are you thinking there of a group of growers organised co-operatively with the factories as their centre? —I am thinking of small ryots, who supply their cane to the factory, who take an advance from the factory and then bring their cane in. Those men will always take artificial fertilisers in small quantity and it can be knocked off what is known as their cane account.

A.1640. Are the firms which are selling fertilisers on a commercial scale in touch with the factories?—I have put them in touch with every factory now.

A.1641. Have they responded?—Yes.

A.1642. Have they got any agency which is ready to do anything for them?—Yes; they have opened a depôt already in Muzaffarpur.

A.1643. You say, "In Formosa companies now give manure free instead of paying bonuses to growers."?—They might give a certain amount of money as bonus, or instead of giving the man half an anna or more they might give him so much manure.

Mr. Wynne Sayer.

A.1644. Is that a bonus on the sucrose-content?—Yes, but we could not do it out here just now, although this method might ultimately be introduced. We have got to get more educated growers before we can take that step.

A.1645. Your note will be printed and I should like to ask you to turn to the first page of the note which is attached as an Appendix to your note of evidence. You say: "Besides maintaining and making permanent the work being done by the Sugar Bureau at Pusa and the Cane Breeding Station at Coimbatore, it is necessary to provide immediately one Imperial farm on the western border of the United Provinces and the eastern portion of the Punjab." Do you refer there to one institution?—Yes; it should be on the western border of the United Provinces and the eastern portion of the Punjab; it will carry both the Provinces.

A.1646. Have you ever considered the possibility of organising the sugar industry for the purposes of research in the same way as cotton is organised?—We had a proposal that they should subscribe to a cess and start some scheme of that description. I think 95 per cent of them have agreed to this scheme but there are a certain number of factories which have not agreed. They thought that Government ought to pay the whole cost of research and that it was not fair to make the factories subscribe.

A.1647. Would you yourself favour such a scheme if it could be financed?—I think it is admirably sound.

A.1648. In that scheme would you attempt to include representatives of the trade: that is to say, representatives of the sugar manufacturing industry and their distributors if they could be represented by a suitable person; in fact, all persons connected with the sugar industry in this country?—I am sorry I do not quite understand your point. Do you mean with regard to the question of this cess?

A.1649. I was thinking of the organisation which the cess will finance?—Certainly.

A.1650. I understand that you have a series of graphs dealing with various aspects of this problem. Would you let us have copies of those?—Certainly.

A.1651. Perhaps you could send them to the Secretary?—I shall.

A.1652. Do you wish to say anything about the import duties?—There is, of course, at present an import duty on sugar. I think myself that, if it was in any way possible, some portion of that import duty might be given for research, though I know when we mentioned the matter on the Sugar Committee, it was not accepted. I do believe that a small portion of it might be given to finance sugar research. The import duty comes to 5 crores and I think myself that sugar would stand an extra 4 annas per hundredweight on the duty.

A.1653. *Sir Henry Lawrence:* In your later note* you have mentioned that the primary work, you consider, is to select out a suitable cane or canes for white sugar making. You have now told us that you are working as much as possible in order to improve the interests of the cane grower?—Yes.

A.1654. From this solitary sentence it would appear that you are thinking more of the interests of the factories. Would you like to tell us anything in this connection?—It is absolutely impossible, as conditions stand at present, to think solely of the interests of the factory. The grower must come first. You cannot grow any particular variety of cane in India for any factory unless the grower approves of it. There is no legislation to make the grower take it up; he can refuse to take it up. Therefore, the cane must always favour the grower to begin with or the factory will get no cane.

A.1655. Can you tell us what proportion of the cane grown in India is at present utilised by factories and what proportion finds its way into the market direct from the grower?—The factories in India make between 70 and 80 thousand tons of white sugar direct from cane, including *gur* refined in modern refineries.

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* Not printed: Note on the work done in the Sugar Bureau, Pusa, prepared by Mr. Sayer for the Commission.

A.1656. *Sir Ganga Ram :* How much do they make by the direct method and how much by converting?—The direct manufacture of sugar from cane is about 40,000 tons, perhaps a little more. The remainder 30,000 tons is made from *gur*. The rest of the cane in India less what is chewed, is made into *gur*.

A.1657. *Sir Henry Lawrence :* What unit of figure would that represent? —The remainder would represent nearly 3 million tons.

A.1658. So that factories only deal with about 3 per cent of the total cane cultivation in India?—2 per cent.

A.1659. Your work here is not limited to the interests of 2 per cent but is equally in the interests of the other 98 per cent?—Absolutely. Our cane has been distributed in Burma. I think it is distributed in every Province except the Madras Presidency.

A.1660. Can you surmise at all what area of land is now being cultivated with Co.213?—Round about here the area is about 12,000 acres. I have at present no figures for the other Provinces.

A.1661. You cannot form any estimate at all?—Not really. I can get the figures for you.

A.1662. I think it would be useful to get the particulars; could you communicate them later on?—Yes, I will.

A.1663. You have told us that you had visited Java; can you give us any information as to the conditions under which cane is grown in Java for the use of factories there?—Factories as a rule have not got their own estate under their own ownership; they lease the land from a village. The land is taken usually through the headman and comprises ⅓rd of the total land of that village. The factory takes it over from the village, opens it out for planting the cane in trenches, plants the cane, grows the crop, and finally returns the land at the end to the village at the end of the crop.

A.1664. Have the individual holders of the land in these villages got the option to give their land for this purpose, or are they bound by any law to do so?—The arrangement is made through the headman of the village, who seems to be able to persuade all the other people in the village to enter into this agreement.

A.1665. You think it is done by persuasion and not by legal force?—I do not think there is any legal force; it is really by persuasion, though weight may be given to it by the tradition of the old forced culture system now abandoned. It benefits the village and financially it benefits the headman.

A.1666. Have you heard about the conditions in Java published in a book by Mr. Keatinge?—I read the book a long time ago. I think it was a report of a tour he made.

A.1667. Perhaps you would look at it and see whether the information given there is correct?—I have got the Report of the Sugar Committee which is more recent than that.

A.1668. You think it is not true that the cultivators are in any way bound to supply their cane to the factory?—No; it is not the cultivators' cane; it is the factory's cane.

A.1669. They are not bound to supply their land?—I do not think that they are legally bound to do so at all. As far as I remember, the arrangement is made through the headman; they have got the right of appeal. A Government officer sees to it that the rent paid is fair. I think the headman manages to control the whole village.

A.1670. Did you investigate this point when you were there?—We carried on a considerable amount of enquiry about it, but there seemed to be silence when it came to some of these facts.

A.1671. That would be very natural?—Yes.

A.1672. Then you state that it is impossible to get a ryot to accept payment on a sucrose basis; are you acquainted with any factory where it has been attempted?—I am acquainted with the factory at Samastipur. They attempted to put matters on a sucrose basis with the European planters, but there were continual quarrels about it. The ryot, whose cane is generally bought at the railway station and paid for there, would never accept such a basis; he would invariably think that he was being deceived or cheated.

A.1673. I understood that this basis had been introduced in the factory at Baramati?—They have a fairly educated ryot there, and they took the cane there on the *gur* value. Paying on the sucrose basis would mean analysing every cart-load of cane and of paying so much for sucrose over a certain percentage. They simply took a sample and calculated the *gur* value for the amount of cane and paid on that basis. On that basis it became impossible to manufacture sugar. The factory is now shut down.

The Commission then adjourned till 10-30 a.m. on Tuesday, 11th January, 1927.

APPENDIX.

Copy of letter No. 2441, dated Pusa, the 8th March 1927, from Wynne Sayer, Esq., B.A., Secretary, Sugar Bureau, Pusa, to the Joint Secretaries, Royal Commission on Agriculture.

I have the honour to state that I want the cess to cover the sugar work of the Sugar Bureau and its proposed extensions as detailed in my note;* it will finance the work of the Cane Breeding Station and any extensions. It will meet the cost of the Sugar Board and expenses connected therewith. It will finance all work on the entomological, mycological, chemical and other scientific sides to be done on sugar by the Central Government. It will finance all farms established by the Sugar Board in the Provinces and will also be available for grants-in-aid of cane work, to the local research and propaganda being done in all cane growing Provinces and enable any further work requiring funds to be taken in hand as occasion arises.

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* Appendix I to "Replies to the Questionnaire," pages 178 and 179.

Tuesday, January 11th, 1927.

PUSA.

PRESENT:

The MARQUESS OF LINLITHGOW, D.L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I.	Mr. H. CALVERT, C.I.E., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.	Professor N. GANGULEE.
Rai Bahadur Sir GANGA RAM, Kt., C.I.E., M.V.O.	Dr. L. K. HYDER.
Sir JAMES MACKENNA, Kt., C.I.E., I.C.S.	Mr. B. S. KAMAT.

Mr. J. A. MADAN, I.C.S. }
Mr. F. W. H. SMITH. } (*Joint Secretaries.*)

Mr. WYNNE SAYER.

Further Oral Evidence.

A.1674. *Sir Henry Lawrence:* Could you tell me anything about the touch that there is between the experiments in Coimbatore and the work in Upper India? Do the Coimbatore officers have any facilities for spreading their results in Upper India on a satisfactory scale?—There is no organisation by which the Coimbatore officers can spread their results in Upper India except the touring done by those officers and the touring which I do. The need for liaison between the work in Coimbatore and the work in the Provinces is, I consider, one of the greatest needs at present. I find it is very rarely that any Deputy Director doing work on cane in the Provinces of Northern India has been to Coimbatore and in consequence it is necessary to advise and help a man of that description far more than it would be if he came down occasionally and saw what was going on. On one occasion I toured in a certain Province to examine a site for a sugar factory. I examined the site and I recommended that they should, on the amount of water they were allowed, grow a certain cane. I told the man that I would send him down this cane or he could obtain it from the neighbouring agricultural station. He replied that that was not the cane that the local agricultural station recommended. I then went to the local agricultural station. I discovered that owing to some reason they had got their canes mixed and were advocating the distribution of the cane I recommended under a different number. That sounds like a thing which could be easily remedied. But if you are recommending a cane under the wrong number, and the people get that cane under the number you recommend from another place, they get a totally different cane and they do not discover their mistake until possibly they put a large area down and incur a big loss. I suspected that this cane was wrongly numbered owing to a mistake and we took the necessary steps to get it put right. But I am positive that mistakes like that are probably occurring every day all over the place and I consider that all the officers who have anything to do with cane and cane work should have an opportunity of coming into much closer touch with Coimbatore.

A.1675. It appears that two things are necessary, first, that the officers of the Provinces dealing in cane should be not merely invited but ordered to go to Coimbatore?—Certainly; I would make it part of their job. If they are going to deal specially with cane they should certainly go to the headquarters of cane breeding. In short, they should go anywhere in India where they would be likely to get assistance and further experience of the work they are undertaking.

A.1676. Do you suggest that Mr. Venkatraman, the Research Officer at Coimbatore, actually has to travel through India like a commercial traveller with samples of cane in his pocket and put them down in different fields?—His tours in Northern India have been to a large extent to show how to grow his cane instead of his doing scientific work. I believe in one year he travelled at his own expense, because his travelling allowance grant was exhausted and he felt that he must go round to some of these places. I could not go and he wanted to see what was going on because he has felt for years, as I have, that the reputation of Coimbatore canes was in such slender hands in the north of India that the canes were very likely to be absolutely damned, not through any fault on the part of the cane but through the fault of the people who were trying to grow the cane in the wrong fashion.

A.1677. You mentioned about cane Co.205. I do not quite understand your answer that the growth of the cane might be a disaster to factories?—Co.205 is a cane of a very strong type which will grow anywhere. It has however a very low sucrose content. Now where you have a body of growers growing cane on their own responsibility and supplying it to the factory they will naturally go all out for a cane which is easy to grow; but it is very low in sucrose content and the factory will therefore lose if such cane gets out into general cultivation.

A.1678. But it is a cane that is of value in certain low-lying tracts?—I am giving it out to those districts with low-lying tracts and for all lands which will not take Co.214, or Co.210 or Co.213.

A.1679. In certain conditions it is of value?—In certain conditions it is of extreme value.

A.1680. Now I notice in the Sugar Committee's Report there was a note of dissent by you. Could you tell us anything further of the subsequent results on those points in which you dissented some seven years ago?—I wrote that note of dissent because I considered that we should have made a definite recommendation in the Report for the licensing of areas. I saw trouble coming in Saran, a cane district over the river here where you have factories having no land of their own. It is always the case in the cane area that a new factory may come along and build near a railway station and proceed to buy cane from the district. Now I dare say you know the limit from which cane can be carted to a factory is ten miles and the limit of the rail haulage is some 80 miles in this district. If a factory is established in a place like Samastipur in a district with no competitors round and is willing to pay a fair rate for cane, it is interested to see that the cane grown all round in the district which comes to it is of the best quality; the growers are also benefited in every way and care is taken to see that their seed is pure and they get manures at a cheap rate. But suppose Samastipur suddenly discovers a new factory put up at the next station Pusa Road—which has a right to buy cane throughout the Samastipur district. Now at once Samastipur factory would say, " Why should I send my men round to distribute good seed and give facilities for manure if you have no guarantee that the cane they grow will come to us?" I foresaw that position was going to occur in Saran and the position is most acute there to-day. Two big factories lately erected are doing extremely bad work due, I think, to the fact that they cannot get cane and to the fact that nobody is now interested in the district. I cannot get my canes distributed except by myself nor can I get facilities for assisting the ryots through the factories because every factory answers, "I do not know to whom to supply this cane."

A.1681. *Sir Ganga Ram :* So you want legislation for it?—I would say, if a factory is doing perfectly good work, prevent another factory from coming in.

A.1682. *Sir Henry Lawrence :* You seem to accept the suggestion that legislation would be required. It is not necessary, is it, supposing you license the factory in a certain area?—But how are you going to stop what is now going on, all the factories congregating round a certain area?

A.1683. What you aim at is a form of co-operation between a factory and the grower which would be of benefit to both the parties?—Yes.

A.1684. The grower is to be assisted in getting good seeds and manure by the factory?—Yes. There is no difficulty about that. The factories are doing it in those areas where we have got control. The only place where I cannot get anything done is in the district I referred to, where the factories are all competing against each other in the same area with no actual control over the cane they are trying to get.

A.1685. And you are quite sure that the interest of the country is concerned with the greater outturn that is secured by this system and that the cultivator will not be damaged by the absence of competition between factories? You know that is the greatest argument against your point?—I know; but I do not see why the cultivator should be damaged. Every factory will pay a fair price for its cane. The small man has always got the alternative of selling his stuff as *gur.* The cultivators know a good deal about prices now. Another point I would like to make is this. When you are attracting cane to a factory you must start at a price which you may not be able to maintain. The moment you go below the price you start with, the supply of cane stops.

A.1686. I take it that you adhere to your note of dissent and consider that you are justified in what you wrote there?—I consider that I have been fully justified. The evidence you will get from the Indian Sugar Producers' Association will back me up.

A.1687. *Sir James MacKenna :* You have got no support from the Sugar Committee?—I got no support whatever. The idea was that I was interfering with the liberty of the individual.

A.1688. *Sir Ganga Ram :* Are you quite sure that legislation like that will be passed by the Assembly?—I am not sure of the Assembly doing anything.

A.1689. Who will govern the price?—The price is governed by agreement between all the factories.

A.1690. Is there any agreement between factories?—There are two factories working up here under agreement.

A.1691. I suppose they pool between themselves?—If I may tell the Chairman I have a witness here who could give evidence on the subject. He is the Cane Manager of the Lohat factory and he will be able to tell you everything.

A.1692. I only wanted to tell you that there is something intermediate between refined sugar and *gur,* what we call brown sugar. Do you know anything about it?—No.

A.1693. You get it by a more careful treatment of *gur;* have you made any research on that?—No; I have no staff to do so.

Recently we saw it in Madras. We had brown sugar for coffee; all the Members know that. It is made in my village at the same place where *gur* is made and they make it very nicely; it is known as *shakkar.* I am sorry I did not bring a sample with me but I will get it to-day. The reason why they do not use the *gur* is they cannot put it in milk or anything like that.

A.1694. You might undertake research with regard to refined sugar of a good kind, at the same time showing the people how to make use of the superfluous material, because the yield must be less than the yield of *gur?*—Yes, but the price will be higher.

A.1695. I got Rs. 8 instead of Rs. 6 this year; I will send you a sample?—I should like to see it.

A.1696. I think a good solution of the problem in one way would be to reduce the consumption of white sugar and induce Indians to take more brown sugar, not in the form of *gur?*—Why do you wish to reduce the consumption of white sugar?

A.1697. To meet the home demand by an indigenous product, thus reducing the import from Java. That is a good argument, is it not?—I do not think it is very sound.

A.1698. Why?—Because it is putting forward a process by which you cannot make sugar as cheaply as it can be made in a first class factory.

A.1699. If you conducted research with a view to improving it by some chemical process, I think that would be a good solution of the problem. I suppose you know that the Java sugar is refined by means of bone charcoal; is not that right?—Yesterday I heard you say that bones were sent to Java and that they came back in the sugar; that gave me rather a shock.

A.1700. But is not bone charcoal largely used in refining sugar?—Bone charcoal is used in refining raw sugar.

A.1701. *Sir Thomas Middleton:* Have you studied the cost of production of cane in different parts of India?—I have collected a lot of figures, but I cannot say that I have particularly studied the cost of production, because the only place where I have had the opportunity of doing any work on the subject has been here, dealing with this district.

A.1702. From the data you have collected can you say whether the cost of production per maund varies widely?—From the data in my possession I should say that the cost of production per maund of these new canes varies from 3 to 4 annas.

A.1703. Does that reply refer to Bihar and Orissa?—Yes.

A.1704. Does it include Bombay?—No, I am referring only to the white sugar tract on which we are working here; I do not include Bombay or Madras.

A.1705. Can you give us any idea of what the cost is in Bombay or Madras?—I can certainly give you the figures, but I have not personally made any experiments to check whether those figures are accurate or not.

A.1706. What are the figures which you accept?—I have a figure for Bombay of Rs. 650 per acre as the cost of growing cane.

A.1707. *Sir Ganga Ram:* Does that include the cost of fertilisers?—I sincerely hope it includes everything, because it is an extraordinarily high figure.

A.1708. *Sir Thomas Middleton:* For how many maunds is that?—That I cannot tell you; I should certainly hope that it went up to 40 tons. I have a figure which was given me when I was last in Bombay; the cane that came into the factory there cost 10½ to 11 annas per maund.

A.1709. Then in Madras what figure have you yourself accepted?—I cannot give you the Madras figure; I can get it for you.

A.1710. No, not unless it is a figure which you yourself have used?—I have given it to people, but I have not verified it; I have done no experiments verifying it.

A.1711. You speak of the use of nitrate of soda in connection with the production of seed cane?—Yes.

A.1712. Cane setts I think?—No, seed cane; that is to say, cane which is going to be used for seed as apart from mill cane.

A.1713. That is what I intended to indicate, the growing of cane setts; cane seed is only produced at Coimbatore?—Yes.

A.1714. Why should nitrate of soda prove to be preferable to sulphate of ammonia?—I find that nitrate of soda, if applied in two or three doses during the rains, grows the cane on, and keeps it green and immature for a longer period than any other manure I have yet tried.

A.1715. It is the successive doses that do the good?—Yes, I think so, giving the last dose as late as possible before the cane stops growing.

Mr. Wynne Sayer.

A.1716. I have not read your note of dissent on the Sugar Committee's Report and I do not yet quite follow your argument. If I were a grower of cane, I should prefer to deal with two factories rather than one?—And then when there was a full crop, what would you do?

A.1717. I should make my arrangement with the factory with which I usually dealt?—You would meet the *jamadars* on the weighbridge; *jamadar* No. 1 would say, "My factory can take no more cane to-day." You have brought your cane 10 miles, *jamadar* No. 2 would say; "My factory also is full." You would go back to *jamadar* No. 1, and he would say: "I will give you 2 annas a maund for that cane."

A.1718. I should not go 10 miles before I found that out. You indicated there was an alternative market, namely *gur*?—Yes.

A.1719. Before going 10 miles with the cane, you presumably would find out whether the factory would take it?—Not when you are an independent grower; you go straight to the station and meet the *jamadar*, and frequently have to face the cost of taking the cane back 10 miles or accepting a price which is much less than the actual figure.

A.1720. I see the force of your suggestion if your difficulty lay in getting capital for starting the industry?—Why getting capital? You can always get capital.

A.1721. Because if you did find difficulty in getting capital for starting a mill in a particular area, it would be a great incentive to those putting down money if you licensed a monopoly for an area?—The difficulty in getting new capital for a sugar concern in an area which would grow cane perfectly well is due to the fact that until the factory comes there the cane is not always there. The factory at Samastipur was started on guarantees from large growers. There was not sufficient cane for a factory before. In places like Saran the cane is there, but it is virtually the property of another factory; you always find capital for piracy, which is what it amounts to.

A.1722. The effect of your restriction would be to prevent piracy?—Where is the benefit of piracy?

A.1723. I understood you, by "piracy," to mean the coming in of a second factory?—Yes. Where is the benefit of that?

A.1724. There is benefit in licensing to persons who have established factories because it restricts competition?—There is no benefit to the grower ultimately in allowing factories to be established without a license, because if two factories are established in this way on one area it ends by both factories working half-time if there is not enough cane, and therefore their expenses go up much higher. Sooner or later one breaks and the other factory is left in charge of the area. What happens then? Generally it happens that the one that is left proceeds to recoup his losses.

A.1725. I quite agree that may happen?—What I am particularly anxious to see is each sugar factory mothering the area from which it draws its cane, regarding the interests of the ryots as its own interests, and helping them in every way, as is being done here.

A.1726. We should all agree if we could guarantee the character of the mother?—I think on Thursday I can produce a couple of gentlemen who will guarantee the character of the mother, as they have already run the arrangement quite well.

A.1727. *Dr. Hyder:* I have had the benefit of reading your note of dissent which you wrote on the recommendations of the Sugar Committee. You are in favour of licensing factories?—Yes.

A.1728. That means restriction of the number of factories in a particular area so as to ensure a constant regular supply of cane to the factories?—Yes.

A.1729. The recommendation of the majority of your colleagues is as follows: "A comparison of the cost of producing sugar in India with the cost in other countries shows that it is in respect of cost of manufacture rather than cost of cane that Indian factories have to fear foreign competition." If you restrict the number of factories and make over a certain area to a particular factory, then you destroy all inducement to the factory to bring about any reduction in cost?—I do not agree. It does not necessarily follow that if the area for a particular factory is demarcated, that factory will not improve its efficiency. Take the examples of Samastipur and Barachakia both factories with no competitors, which are very efficient while Lohat, Japaha and Pusa are steadily improving their efficiency without the stimulus of internal competition from other factories. I consider sufficient stimulus and competition comes from outside India to insure efficiency.

A.1730. I agree with you it would be better to have a factory which gets a constant supply of cane. On the other hand this question of increased efficiency must be solved?—The question of the efficiency of the factory is rapidly being solved; the best of them have improved over 2 per cent since that report was written.

A.1731. *Sir Henry Lawrence :* What does that figure of 2 per cent mean? —Sugar in bag per 100 maunds of cane crushed.

A.1732. *Dr. Hyder :* At present the duty is specific and not on an *ad valorem* basis?—Yes.

A.1733. So that when the price of sugar falls that means there is a higher protection to the sugar manufacturer in India; is it not so?—The specific duty means a regular protection to the manufacturer in India.

A.1734. If my arithmetic, which I did rapidly, is correct, on your figures when sugar is selling at Rs. 38 per maund the rate works out at 8 per cent, while when the price of sugar falls to Rs. 13, the same duty has the effect of a duty of 21 per cent?—That is true.

A.1735. That is desirable from the point of view of the sugar manufacturer, is it not?—I do not look at it from the percentage point of view; I look at it in this way, that Rs. 4 or Rs. 4-8 is the protection, if you like to call it so, that the sugar manufacturer can expect whatever price sugar may drop to; should Java ever manage to land sugar in Calcutta at Rs. 5, the protection of Rs. 4-8 would be very nearly 100 per cent; the sugar would then be at Rs. 9-8, at which a lot of factories would fail to carry on, but some might just exist. On the other hand, if sugar rises to a higher figure, the protection does not increase as it used to with the *ad valorem* duty.

A.1736. They do not want protection then?—Exactly, that was felt with the *ad valorem* rate.

A.1737. You went to Java?—Yes.

A.1738. Can you tell me what use was made of the bonemeal? Was it used partly for manure and partly for refining purposes?—I will discuss the question of bone afterwards.

A.1739. *Sir James MacKenna :* You say that as a result of the non-acceptance of your recommendation to reserve land to factories numerous factories are springing up all over the place. By whom are these factories being put up?—The factories referred to are being put up by Indian firms.

A.1740. So that the acceptance of your recommendation would have been to limit the development of the sugar industry to the large European settlers? —No, it would have been to send these Indian factories to a district where they would certainly have had to take a little time and trouble to work up their supply of cane but they would then have been assured of a proper supply and they would have assisted in developing the industry.

A.1741. With reference to the Coimbatore station, when we were in Madras we heard that a thick-cane expert was being appointed. Is that appointment under the Government of India or under the Government of Madras?—It is under the Government of India.

A. 1742. What is the relation of your Bureau to the work of Mr. Clarke at Shahjahanpur?—It sends him any canes that we think might assist that portion of the United Provinces if he asks for them. It also would give him any assistance which he might require or any figures, and it would willingly help him with any cultivation problems that might arise.

Mr. Wynne Sayer.

A.1743. It would. But does it?—It does not do anything for him at present.

A.1744. Is the Sugar Bureau under the Agricultural Adviser?—Yes.

A.1745. Your idea is, I take it, to develop the Sugar Bureau very much on the lines of the Cotton Committee's method of working?—I want to develop the Bureau so that it may become a Sugar Research Section.

A.1746. In fact it would become stabilised instead of floating about in places?—Yes.

A.1747. *Professor Gangulee:* You are in touch with all research work in connection with sugar?—Yes.

A.1748. Could you tell the Commission what are the chief research problems that need immediate attention?—On which side would you like me to make a recommendation?

A.1749. Let us take the agricultural side?—The chief problems which require attention on the agricultural side are improved varieties of cane. We want to try and produce a cane not only for every Province in India but further than that for different districts and tracts in every Province.

A.1750. Is it the case that Indian sugarcane on an average has low value so far as sucrose contents are concerned?—Indian sugarcane, as far as I have had experience, is chiefly remarkable for its very low tonnage per acre. I believe that an Indian sugarcane is not bad as regards sucrose content, but the low tonnage per acre makes the cane almost unprofitable.

A.1751. Then your opinion is that it is not due to the quality but to the quantity?—Yes.

A.1752. With regard to the technological side?—I have put up proposals for a technologist to be attached to the Sugar Bureau and also I want an Engineer.

A.1753. Then the whole problem of sugar manufacture requires to be tackled?—The whole problem is this, that at present in India we have no technological staff whatever. If anybody puts up a factory and gets into difficulties he comes to us for assistance. I am unable to assist him, greatly to my regret.

A.1754. Referring back to the agricultural aspect of the problem, is any definite research necessary for the improvement of the cultivation of sugarcane?—Certainly, I think a lot of research is necessary.

A.1755. In what direction?—I consider myself that the earlier ripening of canes is linked up here with the time of planting to give them a long growing period. Then there is the question of the depths to plant and further we have got the question which is always arising as to why certain lands will not hold certain varieties of cane. I have at the present moment found that in Saran Co.213 does not do anything like as well as it does on this side of the river, but Co.210 does quite well. That problem requires elucidation.

A.1756. At Coimbatore only the cane breeding work is conducted?—I would not go so far as to say ' only '. I think there are many other lines of work on which Mr. Venkatraman is working.

A.1757. Would it be convenient to have facilities provided there for work in connection with cane pests?—I would prefer that you should address that question to Mr. Fletcher.

A.1758. I want your opinion on the question of linking up the Mycological Section and the Entomological Section with the Cane-breeding Station?—I think that these two sections should be linked up more with where the cane is grown than with where the cane is bred. They should be working up here where the major part of the industry and the crop is to be found.

A.1759. Where would you carry out your experiments and investigations on the engineering and chemical side of the sugar industry?—Here, in this place, which is the centre of the industry.

A.1760. Is it your opinion that the areas under Coimbatore canes are gradually expanding?—Yes, very fast.

A.1761. In Northern India?—In this tract round here.

A.1762. As well as in Northern India?—So far as Northern India is concerned I have no actual figures, but I could vouch for this part of India.

A.1763. *Dr. Hyder:* What is your impression? Are they extending in the United Provinces?—Yes.

A.1764. *Professor Gangulee:* Do you think the present Coimbatore canes have reached their final stage of development?—No.

A.1765. Do you think you will have to have new varieties in future?—I am of opinion that we have got to work steadily on improving not only the class of canes which we are turning out from Coimbatore, but also we have got to watch very carefully when anything turns up that may bring these canes back to a stage where they are unprofitable, such as disease, pests or some such thing.

A.1766. In order to extend the use of Coimbatore canes, do you think it necessary to have a certain number of sub-stations through the Provinces?—Yes.

A.1767. What would be the nature of the work of these sub-stations?—These sub-stations would duplicate the work that we are doing here with reference to the local problems of the Province, and would also get direct from here canes that we have made a success of. In short we should try to run a station which would enable the local officers of the Government in each Province to go a short distance and see exactly what was being done there and the extent to which our experience was of value.

A.1768. These sub-stations would be under Imperial control, under the direction of the Coimbatore station?—No; I would like to have these sub-stations under my own control as regards the growing of cane, and the Cane-breeding Expert of Coimbatore would have all the facilities there for doing any experiments he wanted to do. But as regards the growing of canes I would prefer to have the work under my own control. When you have a scientific officer like Mr. Venkatraman, I consider that his work is especially of value when it is being done at Coimbatore on the specific problems which he is required to deal with. He should not be concerned with the cultivating problems of Northern India.

A.1769. What would be the relations of the provincial departments to the sub-stations?—They would be invited to make use of the sub-stations for advice, etc. The sub-station if it was under me would not be allowed to criticise, or to pass any orders on what the Local Government was doing. It would merely stand there and say, " If you want my advice on any particular point I am ready to give it." It should not criticise.

A.1770. Even if the criticism is helpful?—No, it could always give it unofficially and that would be always accepted.

A.1771. Have you any experience with regard to the method of " short planting "?—When I went to Java I observed there that they had a very rapid and systematic fashion of dealing with it.

A.1772. So that there are good prospects in that direction?—Yes.

A.1773. With regard to the use of sulphate of ammonia as a manure, do you know of any instance where the use of sulphate of ammonia has effected the tilth?—I asked that question myself in Java and I was told that such cases had not occurred, but at the same time their soil may be such as might resist anything of that kind. But I have no experience here; we have not used it long enough.

A.1774. Would you recommend sulphate of ammonia in unirrigated areas?—I recommend it throughout this tract which is an unirrigated tract.

A.1775. You could not tell us whether that has had any effect on the tilth or on physical character of the soil?—It has not been used long enough in this area for us to gather any data.

A.1776. In your experimental work do you feel that adequate information is not available in regard to the water requirements of cane?—I cannot do any work here at Pusa on the water requirements of cane. That would have to be done in the sub-stations in each of the Provinces where cane could be grown. We can only tell you what we can do here on the residual moisture in the soil at the time of planting, the class of cane we can grow, and how to make the best use of the moisture. That we have worked out.

A.1777. You have no plant physiologist in this Institute here?—Not that I know of.

A.1778. Do you not think it would be very useful to have adequate and definite knowledge of what the water requirements of sugarcane are?—I think that work should be linked up with the work that Mr. Henderson has suggested should be done in an irrigated area. It is a work that I should be against trying to start here because I consider that the work should essentially be done in an irrigated district.

A.1779. It should perhaps be under the control of your Bureau?—I would certainly like to undertake it.

A.1780. What is the average percentage of sugar in the variety of cane that you recommend to the grower?—The percentage in juice ranges between 14 to 16, 17, and 19, but, of course, 12 is the minimum which we always demand before a cane is received from Coimbatore.

A.1781. If I remember aright the Sugar Committee recommended a sliding scale, based on a price for cane equal to one-half the price of the sugar produced from it?—Yes.

A.1782. What have you got to say about that recommendation?—I am under the impression that any alteration of scales of payment for cane here at present would be undesirable. At the present moment they pay a flat rate for canes when purchasing them from the small growers. They set their price at a figure beneath which they will not have to go and then they may conceivably raise the price. The small grower carefully considers that rate.

A.1783. Surely, the Sugar Committee knew the particular argument that you were just telling us about, and yet they made the recommendation. Could you tell us the reason of that recommendation?—I think they did it with the idea that it would open the gate to Utopia but I do not think myself that any of the districts is yet ripe to start things of that kind. It may be done by the big growers and educated men.

A.1784. Is *gur* still produced by the ryot in large quantities?—Yes.

A.1785. Is *gur* consumption decreasing?—I have not noticed a general glut of *gur* all over India which would, in my opinion, be the only sign that consumption was decreasing to such an extent that there was not a market for the *gur* made.

A.1786. Is it possible, then, to organise the business of *gur* refining in large factories?—The business of *gur* refining is solely dependent at present on the price of sugar. Whenever the price of sugar rises to a figure and the price of *gur* falls to a figure at which you can buy *gur* low enough you can make it into sugar at a profit. These factories round here operate during the off-season. They are not always out to make a profit. If they can cover their ordinary charges during the off-season, they are content. But I may point out that this method of working in the off-season has frequently coincided with a drop in the sugar market and the factory has been kept with a product which it cannot sell at a profit.

A.1787. I know what happens. I believe it is due to the fact that sugar is in the hands of speculators and *gur* is not subject to speculation?—I think that we could make it a profitable business if we were to start in Calcutta a futures market such as they have in New York where you can sell your sugar forward. But we have no such market.

A.1788. *Sir Ganga Ram:* You can sell sugar forward?—There is no method by which you can be covered during the time of manufacture as is done in the case of wheat and flour, I believe.

Mr. Wynne Sayer.

A.1789. *Professor Gangulee:* With the extension of Coimbatore sugarcane cultivation in India, is there any scope for small sugar factories?—What do you mean by small factories?

A.1790. Factories which are not run on a big scale. We have got only a few large sugar factories in this country?—There are quite a number of them.

A.1791. I think there are altogether 7?—We have got more than that. We have scope here for the smallest factory. I would call it a small factory if it could take about 5,000 maunds of cane per working day.

A.1792. When I say small factories, I mean the factories which can be managed by the growers themselves in co-operation?—I am at present firmly against the grower interfering with the manufacturing side in any way whatsoever because sugar manufacturing is a highly technical subject.

A.1793. The growers themselves will manufacture sugar but they will have a technologist appointed to the co-operative societies?—That is certainly an idea worth considering. At the same time, the process of sugar manufacturing is so specialised that I should be very unwilling to work with a group of growers. A venture of this description should not be undertaken until we have a much increased staff in the Bureau, otherwise the growers will get into difficulties.

A.1794. Do the factories you have here in this Province act as bankers for sugar growers? Do they lend them money?—Mr. Henry will be able to give you that information on Thursday if he is called to give evidence. He does all that.

A.1795. With regard to sugar manufacture, what process do you follow, carbonisation or sulphitation process?—The carbonisation process. The sulphitation process is also followed in other factories.

A.1796. Which is more efficient?—I am answering this question without any experience. I can only tell you that carbonised sugar is supposed to keep colour better and to keep better. Some people think that with sulphitation sugar this is not the case; of course I speak subject to correction.

A.1797. What use do they make of the molasses?—They are supposed to be used for *hookah* tobacco.

A.1798. Are they not used for making alcoholic drinks?—I should think a certain amount of them is used for alcoholic drinks but not a large quantity. I also heard the other day that a certain amount of molasses is used for adulterating *gur.*

A.1799. With the development of sugar factories in the country, would you have to consider the use of molasses?—What about the use of molasses to make power alcohol?

A.1800. *Sir Ganga Ram:* You could make it into molassine by mixing it with megasse?—I do not think there will be a market for it.

A.1801. Have you tried that?—I would if I could sell it to the Military.

A.1802. *Professor Gangulee:* Does your Sugar Bureau organise propaganda such as delivering lectures to the growers or demonstrating cultivation of cane?—I have no staff to lecture.

A.1803. If you had a staff, do you think you could profitably organise propaganda work?—If I had a staff I would certainly set to work at once to organise these people and make them get the canes out three times as fast as they are getting them out to-day. But I have no staff. My two Agricultural Assistants have been taken away from me and my staff has now been reduced to one man on the agricultural side.

A.1804. Do you think a great deal can be achieved by such propaganda? —I am certain of it.

A. 1805. To what extent has the cable service proved valuable in stabilising the sugar industry in the country?—It has proved valuable from the remarks of all the members who are subscribing to it. One of the most frequent remarks made is that, though the report is in the market to the effect that such and such a thing has happened, the individual has always waited till the Sugar Bureau telegram came before he was absolutely certain that it was not a rumour. When our telegram comes, they know the information is *pucca*. We do not profess to be able to give the information before anybody else but we always confirm our information. For instance, there was a hurricane in Cuba which caused a great deal of confusion. When our telegram arrived, all the rumours were set at rest.

A.1806. It helps not only the sugar speculators but also the sugar growers?—Undoubtedly, because it stabilises the price of sugar. A large number of merchants who deal in sugar in India are without any first-hand information from other countries. The big dealers have their private sources for the supply of information and, as they use these sources of supply, naturally it is the small man who gets squeezed. He wants trustworthy information at a reasonable figure.

A.1807. Would a large grower of sugarcane get the information from the cable service?—Not unless he owned a factory.

A.1808. So the grower himself cannot get the benefit of the cable service?—It would not benefit him; he is paid a fixed price.

A.1809. *Mr. Calvert:* I notice that these Coimbatore canes are giving widely different results in different places in the same Province?—Yes.

A.1810. That is largely due to different climates and soils?—I should like to say that it might be due to difference of cultivation.

A.1811. Even on Government farms?—Yes, even on Government farms.

A.1812. Could you give us some idea of the number of varieties that you wish ultimately to obtain? Six or eight or a larger number?—I think myself that only in very few Provinces would more than four varieties be necessary. That is to say, one cane for the best lands, an earlier ripening cane for the northern side where you want early ripening, a cane for light lands, and a cane for low and bad lands. That would give you four varieties. If it were a question of specialising the industry, then we should want a cane for each month of the sugar season. But I do not anticipate that that would come to pass for a number of years. As a matter of fact Co. 213 seems to be doing well in most places.

A.1813. In your note you say on pages 171 and 172 that the thing should be explained to the educated growers first and then let it filter down to the small ryot. Is it your experience that the practice of the educated people does actually filter down?—My experience has been as follows. When we first started to give out these Coimbatore canes, we gathered together all the principal growers round here who were mostly Europeans. We then demonstrated to them and they proceeded to grow the canes on their own land. Now they grow these canes by means of ordinary ploughmen, *jamadars* and the usual menial staff we employ here. Next year the Indian zamindars, who are very often the *maliks* of these European factories, wrote to me or came to me, or went to the European growers and asked for seed, and we supplied them with that seed. They then proceeded to put down the areas under their own cultivation in the same way. After that, the local small growers, the *jamadar* class, owning 5 to 10 acres of land, proceeded to take seed from those people, grew it and made a success of it. Then came the last class of all, the ordinary ryot, who saw that the *jamadar*, the man a little above him, could grow it, and he proceeded to get the cane seed and grew it. My experience has been that, if you go directly from a Government farm, where a loss of Rs. 10 an acre is nothing, and you ask the man to whom the loss of Rs. 10 an acre might mean the loss of his capital, to grow it, you are asking him to take a risk, not an agricultural risk, but you are asking him to take a big risk, because the difference between you with your large farm with every facility and that man is so great that you cannot expect him to take your word for it; you are asking him to believe too much. But if he sees his neighbours, large and small, doing it, he will also do it. I think our agricultural farms are too far away from the small ryot.

Mr. Wynne Sayer.

A.1814. Normally, going round an agricultural farm, one finds that the boundary of the farm is also the boundary of the system of cultivation. Things do not filter out into the neighbouring farms by themselves?—My impression is that things generally filter out at certain places to certain people who are a little more advanced than their fellow cultivators.

A.1815. Any marked improvement would naturally move quicker than some slight improvement?—I say that no man engaged in agriculture is going to turn round for anything under 20 per cent improvement. These 5 per cent and 7 per cent improvements are no good at all. No practical agriculturist is going to disturb his rotation for a 5 per cent or 7 per cent improvement which is less than the monsoon variation. Give him an improvement like the one we gave them in these canes, and he will jump at it; he is not going to wander about for 5 per cent improvements; as a matter of fact, they are not worth putting up.

A.1816. Can you suggest what arrangements should be made through co-operative societies to finance sugarcane growing? If co-operative societies were formed in cane-growing tracts, would you give them preference in the distribution of seed over individuals?—Distinctly.

A.1817. You further suggest that co-operative societies might be formed for special manure depôts, sulphate of ammonia and oil-cakes. Do you think you could guarantee a profit by the sale of these manures?—I can see no reason why, if you bought manure in bulk and brought it up to a central place, and then gave it out in small quantities, you should not make a profit. It is being done this year by the owner of one factory at Bhicanpur, and it is going to be done by two other factories. I think Mr. Atkins and Mr. Henry, the two gentlemen dealing with this matter here, are conversant with the methods. Mr. Atkins is practically the founder and the maintainer of the most substantial co-operative bank in this district.

A.1818. Actually, I have never yet come across manure which the Agricultural Department guaranteed. The societies would be prepared to stock and sell manures if the department guaranteed the profit?—I think myself that sulphate of ammonia and nitrate of soda could perfectly well be sold in small quantities through reliable people. The factories, I know, are prepared to take large quantities and do it. If it passes through a large number of hands, there is no question but that it would be adulterated, probably with earth.

A.1819. *Professor Gangulee:* Messrs. Shaw, Wallace & Co., sell it direct?—It is the British Sulphate of Ammonia Federation. If you send manure up to a man in the bazaar, he breaks it up into small quantities and adds earth, and the cultivator is not sufficiently educated to detect the presence of earth.

A.1820. *Mr. Calvert:* Actually; the experience of co-operative societies with regard to the manures recommended by the Agricultural Department has been rather bitter?—I do not know. We recommend these two manures here, and we have no difficulties. I am not talking about patent sugarcane mixtures. We are recommending the perfectly ordinary manures; these mixtures I know nothing about.

A.1821. Is sulphate of ammonia produced in India?—It is produced at Burrakar. The last lot came from Burrakar.

A.1822. Is it exported from India?—Yes, to Java. The Sugar Committee's Report says, "As we have already mentioned, the greater part of the sulphate of ammonia produced in India is exported to Java and the Straits Settlements."

A.1823. Then you suggest that co-operative *gur* sale societies might do good. Do you think a co-operative *gur* sale society would be able to fight the ring of the middlemen?—That depends entirely on the size of your society, where it was placed, and whether it was prepared to deal direct with the firms buying *gur* for refining. I think if such a co-operative society deals direct, for instance, with Messrs. Begg, Sutherland & Co., who buy an enormous amount of *gur*, they would certainly do better if they cut out the middlemen.

A.1824. Do you not think that it is easier for the middlemen to form a ring than for the people to form a good co-operative society?—I think the middlemen are perhaps better organised than the ordinary people, but that is a thing for the district officials to look into. I see no reason why a large buyer like Messrs. Begg, Sutherland & Co., should not buy direct from co-operative societies.

A.1825. Experience of that has rather been in favour of the middlemen?—Very probably.

A.1826. You have stated that most people in England are interested in farming. That of course is of very recent date?—What do you call recent date?

A.1827. A year or so?—10 or 15 years ago. Even before that time they must have been interested in farming for a long time.

A.1828. From the time of William the Conqueror up to the 18th century there was no improvement in English agriculture?—I think there has been steady improvement, though imperceptible.

A.1829. Practically nothing noticeable. Even in England, Sir Daniel Hall says, the agricultural methods of the Romans are still in vogue?—They have been very good methods in certain districts.

A.1830. The landlord's interest, when aroused. was aroused for the sake of their own pockets?—I think India is a totally different case. I cannot see any sign here of anybody's interest being aroused for the sake of their own pockets. When you come to deal with people of the kind I have referred to in my note, you must remember that their pockets are always filled from other sources.

A.1831. Do you not think that increased profits from land will be sufficient to arouse their interest?—I do not think so. There is one case near here where I think the individual in question has as large a sum of money as he wants, and the only way of stimulating him would be to offer an honour which he has not got at present.

A.1832. On this question, can you suggest any other methods apart from giving honours?—I think if you start at the top and make agriculture fashionable, as I have said in this note, everybody will take it up. For instance, the man I am referring to here, if he were really keen on getting this honour and getting it through his agriculture, would see to it that all the zamindars below him and people of that sort were stirred into life; he is the person who can stir them into life.

A.1833. Having got his honour, what then?—He would then see that all these people did improve things by what they had done. I think you will then find that the question of what he had financially made would become obvious, and he would prefer to stick to it. Once the man has made an improvement, he will stick to it.

A.1834. Your argument is, that in the case of pioneers in agricultural improvement, honours should be given more freely?—My belief is that if India is dependent on agriculture, as we are always being told, agriculture should be made the primary thing for development, and the Honours List does not show, in my opinion, that that is the thing taken into consideration.

A.1835. Suppose you are recommending an honour, would you prefer to see that honour given to the cultivator who had adopted your methods, or to the member of your own staff who had devoted many years to the improvement of a crop?—I should prefer to give it to somebody higher up who could influence the cultivator more than I could do.

A.1836. *Mr. Kamat:* What should be the principle of distribution of honours? Should they be given to the man who does service to himself by doing his own agriculture, or to the man who does service to the public?—To the man who does service to the public. In the case of the people to whom I have referred in my note, they are in charge of large areas of land, and they could be made to stimulate things generally by such honours. I do not expect a Ruling Chief to start farming on his own, but I certainly do think that by means of a judicious distribution of honours, he could be got to take an active interest in the agriculture of his State.

A.1837. You do not think it will be a colossal eyewash?—Still, we must attempt to do something.

A.1838. You have visited Java. Will you please say what the general organisation of Java is with regard to scientific research on cane breeding and other things? How many stations or sub-stations does it have for the size of the country?—It has one station where all the work is carried out, technological, breeding and all other work. The conditions in Java, except up towards the hills and the higher tracts, do not vary to any extent which makes it necessary to have the cane breeding in one place and the technological work in another. Cane breeding goes on in the tract round which factories work.

A.1839. So that organisation will not suit this country; you will require many more sub-stations here?—Yes.

A.1840. Do you mean to say that the ordinary business principles do not come into play in regard to *gur*, and if the price of *gur* here, for instance, is very high, the man at Baramati does not know it?—I do not know for a fact that he does not know it, but I do know this that he seems to make no effort to fill the vacancy.

A.1841. But in the case of other commodities, say for instance grains, if the market for a particular kind of grain in Cawnpore goes up or down, the *bania* for instance, even down in the South, knows that the market is up or down as the case may be; he has his correspondents. Why does not that apply in the case of *gur*?—I do not think that *gur* is a commodity which is dealt in and sold like grains. I think that when you are dealing with food grains, I speak subject to correction, you are dealing with commodities which are easily handled. Most of the *gur* that I have experience of here does not keep during the rains; it becomes a sticky mass; you cannot handle it and send it about; it is difficult to do so.

A.1842. I know it goes from Baramati to places so far away as the Berars?—In that case, if you come upstairs, I will probably be able to explain why this difference in prices exists.

A.1843. It is packed in gunny bags and exported to long distances?—We have upstairs these charts showing the difference in prices. I would like myself to know the reason, but the difference is there.

If the facts are as you say, there should be something like your cable service for internal purposes.

A.1844. Will you kindly tell me something more about the Formosa system of supplying manure?—The system there is that the factory takes the cane from the grower and supplies the grower with manures of a certain kind and takes the cost of that manure, either out of the man's payment for cane or else out of the bonus. The factories in Formosa work with a licensed area; they have no competitor and a fair price is paid.

A.1845. You think that the success of the supply of manure through this system is dependent on licensing?—I think that the supply of manure to the cultivators and everything connected with good cane cultivation is dependent on the guarantee that the factory will receive the improved cane produced by the grower to whom they supply the seed and the manure.

A.1846. Therefore it seems to me it is based on mutual commercial considerations?—Exactly so.

A.1847. Unless you have the licensing, will not the system work here?—I do not think the system will work here because nobody in my knowledge is going to spend money, time and trouble in supplying improved seeds and manures to a man who is not going to supply the cane. They are not philanthropic institutions.

Mr. Wynne Sayer.

A.1848. I know that in the Bombay Presidency, at least, manure is supplied by private agencies?—I do not think these two factories take cane from each other.

A.1849. No; but the point I was going to mention was that there is no guarantee test if the cultivators are dissatisfied with the kind of manure they receive through these private agencies?—No guarantee test. But then the factory is not going to give an inferior manure, for the loss will come back on the factory.

A.1850. You are speaking about an area where there are factories; I am talking of an area where there are no factories. In such a case I want to know whether you have any suggestions to make as to how the cultivator is to get guaranteed manure?—I think the co-operative societies, if they deal direct with the firm, might solve it. They would get their manure in bulk and they would get a perfectly unadulterated article.

A.1851. Will the Agricultural Department undertake to do this?—I think that is a question which you should ask the Provincial Director.

A.1852. I suppose you have seen the Baramati sugar factory. I should like to ask you what, in your opinion, were the causes of that company being shipwrecked?—I would prefer to tell you later.

A. 1853. In *camera*?—Yes.

A.1854. Speaking about import duty; even assuming all circumstances to be favourable and that you carry on research with early ripening varieties of sugarcane and you start model factories, as you propose, in one or two centres in India to stimulate the manufacture of white sugar, do you foresee the time when India can stand competition with Java and other countries in the manufacture of sugar?—I do foresee a time when India can dispense with foreign imports if the problem is attacked vigorously from all sides.

A.1855. If you do, do you think it can stand on its own legs without any import duty as a protective measure?—When the Indian industry is properly organised and developed and is fully efficient, I consider that the protection afforded by the handling of the imported sugar, the freight from a place like Java, the railway freight up to the centre, will be sufficient to protect the industry, that is, when it is fully organised and is on a basis equivalent to that of Java. In saying that I refer to the fact that a factory in Java does not pay two profits. Every factory that I know in India at present pays two profits, that is to say, pays a profit to the cultivator on his cane and then has to make a profit on the sale of its sugar. Java does not do that. The cane comes in at the lowest cost price.

A.1856. In other words you suggest that, for the country to stand on its own legs at some future date, what you will have to achieve is more research on the scientific side, and on the commercial side, organisation such as you say there is in Java; these two things must proceed side by side?—Yes.

A.1857. Do you visualise the time when you will come to the same stage as Java in evolving good types of sugarcane, say, within 15 or 20 years?—I think as we are working at the present moment we shall, if we are given the staff and the money, and the assistance and the opportunity to go to different places and see what other people are doing. I do not see any reason why, with the variety in the different canes at our disposal, we shall not be able to breed the cane for every tract in India.

A.1858. A cane which can stand competition with the varieties in Java?—Yes; a cane which should be able to compete with the varieties in Java subject to the difference between tropical Java and sub-tropical North India.

A.1859. And from that point of view it would be a good investment for the Government of India and the community to take all the steps which you suggest?—I think it will be an excellent investment for the Government of India to put the sugar industry in India on a basis where it could stop the present drain out of the country, roughly 15 crores of rupees for Java sugar, and in addition would enable us to be in a position to supply the ever increasing amount of sugar to those tracts which now consume *gur*. I think in the time you refer to, 25 years, the tracts in India which now consume *gur* will be demanding sugar and if we are not in a position to supply that sugar from sugar made in India it will be supplied from outside.

A.1860. If it would take 25 years as you say for us to reach that stage, during the interval are you in favour of a protective duty?—I am in favour of keeping the duty as it stands until we have got the industry in a position to keep itself going. I think if we tamper with the duty, or reduce it, or remove it, we shall simply involve the country in a far greater loss than if we had never put on the duty at all and had prevented the industry from expanding. I myself think that the position of things in Bombay should show you that.

A.1861. Would you go even a little further, as you suggested yesterday, and raise the present duty, provided the additional 4 or 8 annas goes to supply the funds for research and other work?—I think that you could raise it to Rs. 4-8 or Rs. 4-12.

A.1862. Even up to Rs. 5?—I do not go as far as that. It will not mean less consumption.

A.1863. You suggest two model factories in India for showing the people how to manufacture sugar?—I suggest one for the purpose of teaching students the process of sugar manufacture. We suggest a model factory for the Punjab so as to get the industry up there organised and to show the ryot that he could make a profit by selling cane to the factory. I adhere to that idea.

A.1864. You would not have a model factory at the Imperial farm?—I would have a small model factory here. If a man is going to learn sugar manufacture he may just as well come up here.

A.1865. By the starting of mere model factories for training would the manufacture of sugar be stimulated in the country? Is that the experience of the Government of India?—My idea is that the manufacturer of sugar in the country would be stimulated if you could get expert staff in the country without having, as at present, to get that expert staff at great expense from outside.

A.1866. I do not want to go into very many instances but I should like to come to one instance which has some bearing on the question. At Dehra Dun, Government started a model plant to show how paper could be manufactured in India. Has it stimulated the manufacture of paper in India?—It has led to the supply of paper made in India available for printing a widely read paper.

A.1867. What I am driving at is this. The mere establishment of a model factory by Government does not necessarily lead to the manufacture of that article or commodity in the country?—When I referred to a model factory I think you misunderstood me. I referred to a factory to show students how to manufacture sugar, the process and that sort of thing, to render them capable of getting jobs as managers or engineers in any sugar factory which is going to be put up, not to show the general public how to make sugar, because it is for those trained students to do that when they are qualified.

A.1868. Have they got many factories to work in?—There are plenty of factories. I do not think they would have difficulty in that.

(The witness withdrew.)

Dr. F. J. F. SHAW, D.Sc., A.R.C.S., F.L.S., Officiating Imperial Economic Botanist, Pusa.

Replies to the Questionnaire.

QUESTIONS 1(*a*) and 4(*a*) & (*b*).—ADMINISTRATION.—The organisation of the existing Agricultural Departments in India is based on the division of the country into Provinces. It is obvious that the different economic, climatic and edaphic conditions which prevail in various parts of the country, and which determine the type of agriculture and the crops grown in any part, are not limited by political boundaries and that a more ideal scheme of agricultural organisation would have based the divisions of the Agricultural Service on a consideration of these factors rather than on the existing provincial frontiers. The organisation which has grown up has resulted in the same problems being investigated in different Provinces by different workers, who are debarred from crossing their provincial boundaries and conferring together on problems of mutual interest. The cause of scientific research has in the past undoubtedly suffered from the infrequent gatherings of scientific workers, whose intercourse has in practice been restricted to the sectional meetings of the Board of Agriculture.

The most efficient organisation for agricultural research and development would be that of a single department for the whole country, the divisions of that department being based on agricultural problems instead of on administrative areas. It cannot however be denied that the creation of such an organisation at the present time would be against the trend of political development in India which is in favour of provincial autonomy. It is probably too late to attempt any such reform but it should not be impossible to devise some scheme which would strengthen the liaison between the different provincial departments and, while leaving them free to develop the work of demonstration and propaganda on their own lines, would assist in securing a uniform and continuous policy of research on the major problems which lie before them.

It appears to the writer to be the duty of the Government of India to undertake the work of co-ordinating agricultural research on the major problems which confront the different Agricultural Departments in India. This could be done by the establishment of bureaux, working under a Research Council. The bureaux would each deal with the research work on one of the major problems and would be charged with the duty of collecting information as to the progress of work in other countries and receiving periodical reports from workers in India. Each bureau would submit reports to the Research Council whose duty it would be to advise the Government of India on the progress made and on the allocation of funds for future work. The bureaux would each require a Secretary, who should be one of the research workers in the subject with which the bureau deals; the Heads of Sections at Pusa could be secretaries in most cases. In the early stages these bureaux could thus be established with very little cost and without withdrawing any officer of the Imperial Agricultural Service from the work on which he is at present engaged. It must be recognised that the work of the Secretary of a Bureau would be of a technical nature and would not involve an officer of the Agricultural Service in administrative details for which he is not suited by training. A bureau would include in its members all the research workers on a particular problem, both officers of the Imperial Department of Agriculture, and of Provincial Departments of Agriculture. Annual meetings of the bureaux would be necessary and would replace the old sectional meetings of the Board of Agriculture. The number of bureaux required would not be large. Sugarcane already has its bureau and the research work on cotton is guided by a committee, probably 5 or 6 new bureaux would suffice to cover all the major problems of Indian agriculture. The bureaux might be allocated to the following problems:—(1) soils, (2) plant protection, (3) cereals, (4) sugarcane,

(5) cotton, (6) industrial crops, *e.g.*, jute, tobacco, oil-seeds, (7) cattle and veterinary, and (8) entomology.

The Research Council should consist of the Agricultural Adviser to the Government of India, the Director of Pusa, the Secretaries of bureaux and additional members, who would be co-opted from Provincial Departments of Agriculture and important industrial interests as the subject under discussion required. A necessary corollary to the establishment of a Research Council would be the creation of a fund which would be used by the Government of India as the Council advised. This fund would be available for:

(1) Strengthening the number of research workers in any bureau by appointments to the Imperial Department. Such new appointments would not necessarily be at Pusa.

(2) The establishment and maintenance of research and testing stations, directly under the bureau wherever the Research Council considered that such action was needed to supplement the work of the local Department of Agriculture or to initiate a new line of work which the provincial department was unable to undertake.

In the case of crops which are the basis of big industries, Government might receive financial assistance towards the expenses of research from the industry itself. This has, I believe, happened in the case of jute and recently a commercial firm offered to contribute towards the cost of the tobacco experiments now in progress at Pusa.

With the establishment of a Research Council the Board of Agriculture would no longer have on its agenda subjects of a scientific nature and could adopt a more popular programme and character; it would then be desirable to change the constitution of the present Board of Agriculture so as to include a considerable proportion of non-official members. The best way of doing this would be by the creation of an All-India Agricultural Association the membership of which would be open to all who are interested in the agriculture of India. The present Board of Agriculture might then become a council of the new association; such a council by being open to non-official members would possess an influence in the country which the Board of Agriculture has never attained.

Scientific officers and agricultural officers should be relieved as far as possible of administrative work and when circumstances render it desirable that they should undertake an administrative post they should not be required to do so in addition to their technical duties. In this respect the existence of the post of Joint Director at Pusa is a hindrance to the professional work of the senior officers and the appointment of a full time Director is a much needed reform. The Director should be selected from among the officers of the Indian Agricultural Service, not necessarily from the staff at Pusa, and would take charge of all the details of administration and preside over the Pusa Council. The Joint Director being himself Head of a section cannot at present discharge these functions. This reform would give the Agricultural Adviser, who is at present also Director of Pusa, more time for the duties of the senior post and would allow every section the exclusive attention of the officer at its head.

The Agricultural Adviser to the Government of India should be stationed at the headquarters of Government and should be a member of the Legislative Assembly. He should be provided with three or four assistants, recruited from the senior officers of the Agricultural Service, who would tour throughout India and keep the Agricultural Adviser in touch with the progress of the work of the provincial departments. Some assistance of this nature appears to be essential if the Agricultural Adviser is to carry out the administrative work of his post at headquarters and also to perform the duties of inspection.

QUESTION 2.—AGRICULTURAL EDUCATION.—The only type of agricultural education in India with which I am familiar is the training of post-graduate students at Pusa. The course in economic botany lasts two years and was instituted in its present form in 1925. The section has accommodation for

4 students so that two students are taken each year, provided candidates reach the required standard. The standard required of candidates is that they should possess a good M.Sc. degree in Botany from one of the best Indian Universities. Up to the present time two students have completed their training and one of these has received an appointment in the Superior Service. The other has only just left Pusa. Two students are at present under training.

I consider that, provided a high standard of academic qualifications is rigorously maintained in the selection of students, the training given at Pusa is more suited to the requirements of Indian recruits for the Indian Agricultural Service than any which could be obtained in Europe. In economic botany, for instance, the student is actually working on the crops which will form the subjects of his investigations in any Province to which he may be appointed. He is also working under Indian conditions of climate and soil and the fact that crops are growing at Pusa during both the rains and the cold weather means that the student does as much in 12 months at Pusa as he could achieve in 2 years in Europe.

The Indian student, who possesses a good M.Sc. degree or its equivalent, is excellent material for training for the botanical side of the Indian Agricultural Service. He suffers however from certain disadvantages in comparison with the product of an English University. These disadvantages are connected with his early education rather than with any defect in the instruction which he has received at his University in his special subject. The English schoolboy leaves his school with a sufficient knowledge of French and German to render the scientific literature of both these countries accessible to him. The Indian naturally has not got this knowledge, since he is compelled to spend a good deal of time in attaining a high standard of English before he can commence the study of any branch of science. The Indian botanical student also receives a much less thorough grounding in the fundamental subjects of mathematics, physics and chemistry than his European colleague; this sometimes leads to an inadequate appreciation of the biological problems which confront him. Of these two difficulties the lack of knowledge of French and German can be remedied by instruction at Pusa. The elementary training in physics, mathematics and chemistry can only be remedied in the Indian Universities.

I think that the students who are appointed to the Indian Agricultural Service after training at Pusa should serve on probation for two years and should then be sent to a University in Europe for one year. By the time that they go to Europe they will have acquired some experience in their subject and will be in a position to derive benefit from the stimulus of meeting new conditions and other workers.

QUESTION 3.—DEMONSTRATION AND PROPAGANDA.—(*d*) The most striking instances of successful propaganda by the Agricultural Departments are furnished by the spread of the improved seeds introduced by the departments. Among the most successful which have come under my observation may be mentioned :—

(1) Pusa wheats in Northern India, (2) Pusa tobacco in Bihar and the United Provinces, (3) improved types of jute by the Bengal Department of Agriculture, (4) Coimbatore sugarcanes in North Bihar, (5) improved types of paddy produced by the Bengal Department of Agriculture, and (6) the introduction of quick growing varieties of ground-nuts in Khandesh and North Gujarat by the Bombay Department of Agriculture.

The reason for success in these cases is that the ryot is not slow to take up an improvement once it has been demonstrated to him, and provided it does not involve capital expenditure. The improvement of crop yields by the introduction of better seed is however but one side of the propaganda work done by the Agricultural Departments. The preservation of crops from the depredations of those pests and diseases which do so much to lessen the return which the agriculturist obtains for his labour has received close attention and the application of scientific methods, which are within the financial means of the ryot, has in certain cases, achieved notable results. The fight against the smut disease of *juar* in the Province of Bombay is a case in point. This disease can be prevented by steeping the seed in a solution of copper sulphate before sowing. The Department of Agriculture has introduced the practice of seed steeping among the agriculturists of the Province and there is an annual sale of 40,000 to 50,000 packets of copper sulphate. These packets are offered to the public at a cost of one anna per packet and are supplied with printed instructions in vernaculars and English. It is estimated that this disease causes an annual loss in the Bombay Presidency of about 5-10 per cent of the crop, which is equal to about 10 lakhs of rupees; during the past year seed treatment was carried out over about 350,000 acres and this method is now becoming established as part of the ordinary agricultural practice of cultivators of *juar*.

QUESTION 11.—CROPS.—(*a*) (*i*). The Botanical Section at Pusa is primarily concerned with the improvement of crops by plant breeding, that is, the production of new and superior types by selection and hybridisation. A new type may be an improvement on the existing crop because it is—(1) superior in the quality of its product, (2) heavier in yielding power, and (3) resistant to disease.

The third property may of course be a potent factor in the increase of yield. The achievements of the Botanical Section at Pusa, during the past 20 years, have already been submitted to the Commission in the memorandum describing the work of the Section.

Examples of the improvement of crops by selection are afforded by the success of Pusa 4 and Pusa 12 wheats, gram types 17 and 25, linseed types 12 and 121, *Hibiscus cannabinus* type 3 and tobacco type 28. The Pusa wheats, linseeds and grams are superior both in quality and yielding power, and the two former are in many areas resistant to rust disease. The Pusa types of *Hibiscus cannabinus* and tobacco are superior in quality and command a higher price. The wheats Pusa 52 and 80/5 are examples of improvement by hybridisation. Pusa 52 is a hybrid between Pusa 6 and Punjab 9, it is a bearded wheat which is increasing in popularity. Pusa 80/5 is a hybrid between Pusa 4 and Pusa 6, it is still under trial. At the present moment work is in progress on wheat, tobacco, linseed, gram, sugarcane, oats, *arhar* and other crops and new types are being produced by selection and hybridisation.

It should be recognised that there is a limitation to the improvement of crops by plant breeding and that limitation depends upon the indigenous agricultural practice. A heavier yielding type must make greater demands on the soil and its introduction should be accompanied by a change in the local system of agriculture which will enable the soil to regain its fertility. Unless this is done the yield of the new type must inevitably deteriorate until a new balance is struck between crop production and the regeneration of soil fertility; this balance will probably come somewhere about the level of the old yield of the local crop.

The breeding of types which are resistant to disease offers at present one of the most promising lines for the improvement of crops in India. The Botanical Section at Pusa is working on this subject in collaboration with the Mycological Section. At present a joint research is in progress which has for its object the isolation of a type of *arhar* resistant to wilt disease and the types of linseed and gram, which have been isolated in the Botanical Section, are being tested for wilt resistance in the Mycological Section. Further work on these lines will be taken up as opportunity offers when the new types which are being produced in the Botanical Section are available.

The introduction of new crops from other countries is one of the easiest methods of improving agriculture. The new crop however does not always succeed in its new home and under these circumstances an improvement in the local crop may sometimes be effected by hybridisation with the local type. Thus European oats are not a success in Bihar and at the present moment experiments are in progress in the Botanical Section which have for their object the crossing of these oats with selected local types and the ultimate improvement of the oat crop by the production of a new hybrid oat. A recent importation which has proved a success is that of Adcock tobacco. This tobacco was introduced into India by a commercial company and is one of the best of the American cigarette tobaccos. It yields in India a bright leaf and is being used in the Botanical Section as one of parents in some crossing experiments which have for their object the production of a high grade Indian cigarette tobacco. The crop of Adcock tobacco which is being grown in India under the agency of the company will this year probably cover 12,000 acres and reach a yield of 8,000,000 lbs.

(*iii*) The distribution of seed of improved varieties of crops is carried out in India almost entirely by the agency of Government Departments of Agriculture. The introduction of the Pusa wheats into the United Provinces and the Punjab was accomplished by raising the seed crop at Pusa, and also on local indigo estates, where the crop was under inspection by the staff of the Botanical Section, and sending the seed to the Departments of Agriculture in the United Provinces and the Punjab. These departments then multiplied the seed on their own farms and distributed it to growers. The use of private estates for the production of seed enabled a very much larger quantity of seed to be produced than would have been possible had the area under the seed crop been restricted to the land available for this purpose on the Pusa Estate, and, as a result, the area under these wheats increased very rapidly. A similar use of indigo estates in Bihar has been made by the Bengal Department of Agriculture for the production of seed of the improved varieties of jute which have been produced by this department. In this case the object of growing the seed crop in Bihar was chiefly to avoid contamination with inferior jute such as might result if the seed were raised in Bengal. The actual distribution of jute seed to the ryots in Bengal was at one time carried out by selling the seed in As. 4 packets at the police *thanas*.

The demand for seed of the Pusa types of wheat, linseed etc., is always in excess of the quantity which can be produced in the Botanical Section. Most of the seed grown in the Section is supplied to the Provincial Departments of Agriculture who thus periodically renew their seed supply and maintain the purity of their product. These Departments of Agriculture multiply the seed and distribute it to ryots in their Province. They naturally maintain a high standard of quality and purity in the seed which is supplied to the public through their agency but there is at present in India no legislation such as regulates the supply of agricultural seeds and protects the purchaser in other countries. In those countries where Seed Laws exist, vendors of seeds are required to furnish a written or printed label containing a statement specifying (1) the commonly accepted name of such agricultural seeds, (2) the percentage by weight of purity or freedom of such seeds from foreign matter, (3) the percentage of germination of such agricultural seeds together with the date of test, (4) the full name and address of the seedsman, dealer, etc. The law holds the dealer responsible for the accuracy of such statements and thus enables the purchaser to inform himself as to what he is buying. Any infringement of these orders makes the dealer liable to punishment.

Seed testing and the certification of seed have now become matters of international interest, and progressive countries have all established seed testing laboratories where thorough and scientific analyses of samples of seed are made and certified for a nominal charge. As long as the supply of pure agricultural seeds is restricted to Government departments such legislation is scarcely needed in India but with the growth of private enterprise some systems of certification of seeds will be required to protect the Indian ryot.

(*c*) The efforts of the Botanical Section at Pusa in improving crops have been successful in the case of wheat, gram, linseed, tobacco and *Hibiscus cannabinus* and an account of the success of the Pusa varieties of these crops will be found in the memorandum already submitted to the Commission, in.

the Annual Reports of the Section, Memoirs of the Department of Agriculture in India, (Botanical Series), in the Pusa Bulletins and in the *Agricultural Journal of India*. It is estimated that the area under Pusa wheats in Northern India is now well into the second million acres and that the increased profit to the growers is about Rs. 15 per acre. The dividend on this item of work is therefore well over a million sterling a year. The Pusa tobacco type 28 was estimated four years ago to be growing over about 50,000 acres, the value of the crop being about Rs. 25 per acre above that of the local kinds. The Pusa linseeds have given yields about 40 per cent higher than the local type in trials at Pusa and have a good oil content. They are being grown on an increasing scale by an oil crushing factory in Bihar and the demand for this seed is increasing. In addition to the success which has been achieved in India it is worth mentioning that Pusa wheats have taken prizes in Australia and indeed Pusa 4 is one of the wheats distributed by the Queensland Department of Agriculture. The Pusa linseeds have been tried in Iraq with marked success and it is probable that one of these will be adopted by the local Department of Agriculture for distribution. An account of the improved seeds which are now available from the Botanical Section at Pusa has recently been published (*Agricultural Journal of India*, Vol. XXI, page 190, May 1926).

Dr. F. J. F. Shaw.

Oral Evidence.

A.1869. *The Chairman:* Dr. Shaw, you are the Imperial Economic Botanist?—Yes.

A.1870. You have prepared for the Commission a note of the evidence that you wish to give. Do you want to say anything in amplification of that note at this stage?—No.

A.1871. Are you satisfied with Pusa as a site for this institution?—Yes. Of course the ideal site for an institution like this would be a place which could grow all the crops in the country and was equidistant from all the important centres; but that cannot be realised. Here, in Pusa, the only disadvantage is the travelling facilities to the place. The communications are bad and there is no reason why they should be as bad as they are at present. They were much better 17 years ago.

A.1872. You mean more convenient connections?—Yes, the railway connections were more convenient than they are now. Otherwise here in Pusa, so far as Northern India is concerned, we are roughly between Eastern India and North-Western India and I think we can grow most of the crops, with the exception of cotton, which are grown all over Northern India from Assam to the North-West Frontier.

A.1873. How about the co-ordination between department and department at Pusa? Are you satisfied with that?—Yes. I have always found it quite easy to co-operate with my brother officers in other sections.

A.1874. Are you satisfied with the touch between Pusa and the Provinces?—Not altogether, because I think, as you will see from my note, the whole organisation of research in India needs revision. The agricultural problems which confront the different Departments of Agriculture are not limited by the political boundaries of the different Provinces and we should have some organisation (I have sketched an outline of the sort of thing that appeals to me) which will co-ordinate the research work on the major problems all over the country.

A.1875. Do you think it feasible, in the face of the Reforms, to attempt to organise research and demonstration in the territorial sense in accordance with the distribution of the crops?—I think so. Perhaps not demonstration; that must be left, I think, to the local Departments of Agriculture, but I see no reason why research work should not be organised under bureaux, such as the Sugar Bureau which you have just examined, and the Cotton Committee. I see no reason why the research work on the major problems should not be organised on those lines.

A.1876. It has been found a great deal more easy to finance the Indian Central Cotton Committee than one would expect in the case of crops which are not export crops?—Yes, that I imagine, is the case. Finance and that sort of thing is not my concern.

A. 1877. Have you anything, other than that which you have set down in your note, which you would like to say about the teaching at Pusa?—I would like to say that considering the fact that agriculture is of such supreme importance in India the number of students studying, say, economic botany, is perhaps from that point of view small. But considering also the fact that practically the only employment for these men when they are trained is by filling the vacancies in the different Government Departments of Agriculture, then I think that the number of students is quite enough. We have more students than there will be vacancies for in Government service.

A.1878. Have you yourself any experience of demonstration and propaganda?—At one time in my service I was stationed in Madras for six months and I had charge there of the spraying operations against the palm diseases on the West Coast. That is practically the only experience I have had. It was only for a short time.

A.1879. Do you think that officers engaged in demonstration can do useful service by bringing to the notice of those who direct research practical problems with which the cultivator is faced?—Yes, I should think so.

A.1880. Under the present arrangements, as you have told the Commission, demonstration is carried out under provincial organisations?—Yes.

A.1881. Do you think that, under these conditions, demonstrators in the Provinces are in a position to bring to the notice of officers at Pusa problems upon which attention ought to be directed?—Under the present organisation, no. But there is much chance for the people who are engaged in the demonstration work to bring to the notice of the research workers at Pusa those particular points which may catch their attention.

A.1882. Your note is very full and I have at this stage very few questions to ask you. I think my colleagues would like to hear from you what your own training and past appointments have been?—I was educated at the Imperial College of Science, London. I went there in 1904. I took the Associateship in Botany of that college in 1907 and the Honours B.Sc., London University, in 1908. After that I was on the staff of the college under Sir John Farmer for two years and was engaged in teaching and research work. I came out to India in 1910 and was posted to Pusa as Assistant to Dr. Butler. In 1913 I was posted to Coimbatore to fill a leave vacancy for six months. I returned to Pusa at the end of that and I have been here ever since. I succeeded to my present appointment in 1924. I have practically been at Pusa during all my service.

A.1883. Were you at Pusa when Mr. Howard was here?—Yes, for 15 years or more.

A.1884. Did you work directly under him?—I did not work under Mr. Howard at all; I was under Dr. Butler.

A.1885. *Professor Gangulee:* Where did you get your training in plant genetics?—Generally as a part of the botanical course when I took my botanical degree.

A. 1886. But you were originally a mycologist?—I specialised in Mycology when I came out here. I took my D.Sc. in Botany in 1916 at the London University.

A.1887. *The Chairman:* Do you see a great field of work before your department?—I think there is and there always will be, because in my work no finality can ever be reached.

A.1888. The question to decide is which problem you should tackle first? —Yes.

A. 1889. Who, in fact, takes that decision?—The responsibility as to the work that is done in the section rests with myself. But I submit the new work that I take up to the Director of this Institute before starting it. That is the rule of the Pusa Institute.

A.1890. That is, if you come to a point where new work is to be taken up and there is a question as to which of the crops should receive attention, you submit your ideas on the point to the Director and he decides?—That is according to the Pusa rules.

A.1891. Do you know whether the Director decides that question on your notes and his own experience, or does he consult the Heads of other sections? —I think in theory it should be done by the Pusa Council, but in actual practice, of course, when there is a choice between several problems the man who has to do the investigation is always attracted more by one problem than by others, and the Director generally would adopt the suggestion which appealed most to the man who had to do the work.

A.1892. What is the constitution of the Pusa Council?—It consists of the Director and the Heads of the Sections.

A.1893. So that you are a member of the Council?—Yes.

A.1894. When was the last meeting that you attended?—The last meeting was very recent. I think it was convened possibly three weeks ago.

A.1895. I was wondering whether, in your experience, such questions as the way in which a problem is to be tackled are, in fact, submitted to the Council?—As a general rule they are not, and the meetings of the Council have been very few.

A.1896. I suppose these crop problems are very often capable of being tackled in their component parts section by section, as, for instance, the botanical aspect of the problem and possibly the chemical aspect of the problem?—Yes; there is one piece of work which is under investigation by two sections, that is to say, by the Botanical Section and the Mycological Section.

A. 1897. How is that particular experiment arranged for?—The Mycological Section was working on the disease and it really arose out of a conversation between Dr. McRae and myself.

A.1898. It was not co-ordinated by the Pusa Council?—It was not. Dr. McRae was working on it and we discussed the matter and decided to take up the subject from the point of view of plant-breeding and simply took it up. On the other hand, the proposal regarding the tobacco investigation, the study of the American tobaccos and their crossing with the Pusa type 28, was submitted to the Director and it was sanctioned.

A.1899. *Sir James MacKenna:* You consider that, as the provincial departments are strengthened, applications for help to Pusa are likely to be fewer; is that your experience?—I think the applications for help to Pusa become fewer because the provincial departments know that if they make an application to Pusa for assistance, the touring expenses of the officer who visits them would be charged to them.

A.1900. That is a new rule under the Fundamental Rules?—That is a new rule under the Devolution Rules. During the last few years since that rule has been in force, I think there have been hardly any applications for assistance, for a personal visit, by the members of this Institute to the Provinces.

A.1901. So that the Devolution Rules are a very serious limitation on the relations of your Institute with the Provinces?—It is. Even supposing that I have money in my allotment for travelling allowance which would permit of my undertaking a piece of work for a Province, yet, if the Province asked me to do that and even if I am prepared to spend my grant on that work, the Province will have to pay for it.

A.1902. In the old days it was the custom to give short courses of lectures. Am I correct in understanding that they have been stopped under similar rules?—I think the Government do not look with a kindly eye upon them. The only students I have had in that way have been the students in animal husbandry from Bangalore who came here for a couple of months.

A.1903. But these students were under the Government of India?—Yes.

A.1904. I have heard that they have stopped these short courses because the view of the Government of India is that they are a provincial concern. Is that correct?—That is correct as far as I know.

A.1905. In view of all these limitations, do you think it would be possible, without any great financial readjustment, to organise work on some of our scientific subjects by bureaux such as you have suggested to the Chairman; these bureaux would meet regularly, and would consist of representatives of the workers in the Provinces and at Pusa?—That is my idea. I think these bureaux should be organised on the problems and not on the subjects. I would not have a Chemical Bureau but I would have a Soil Bureau.

A.1906. Do you consider the abolition of the sectional meeting to be a mistake?—They died a natural death from the travelling allowance consideration. The Provincial Governments in some cases would not meet the expenses of the officers. I think that was a great mistake.

A.1907. Now on the question of teaching. How many recruits have there been to the Imperial Agricultural Service on the botanical side during the last 5 years?—I am afraid I could not give you the number off-hand, I have no doubt that the figure can be obtained in Pusa.

A.1908. Are they a small number or a large number?—I should say, small.

A.1909. You could not give us the approximate recruitment for the last 10 years?—I should not care to do that.

A.1910. Would you say that it would be large or small?—I should not think that it would be large, but I should not care to give it. What do you consider to be large?

A.1911. I should consider 20 large?—I dc not think it is as big as that.

A.1912. In view of the fact that there are so few posts available in the Imperial Agricultural Service, do you think that undue emphasis is being laid on the question of post-graduate training at Pusa, and would you not be simply providing a course which would very seldom be used?—If the Provincial Departments of Agriculture filled their vacancies from men who have been trained at Pusa, I should think there would be one vacancy in a year and I am supposed to turn out 2 students every year.

A.1913. One of whom may get a job and the other may not?—That is what I had in my mind when I said, a little while ago, that I do not think the number of the students is small when you consider the prospect of subsequent employment for them.

A.1914. You know that it has always been a reproach that little is done in the way of teaching. Do you not think it would be better to give up the present kind of post-graduate teaching and to start something like what is given at the Rothamsted Institute, *i.e.*, courses for specialised workers or refresher courses?—You mean a refresher course, with a view possibly to promote people to the higher grade?

A.1915. Not necessarily. Men in the service might want to go to Pusa to keep themselves in touch with the library and laboratory. There might be study leave courses for the Indian members of the service?—That would not appeal to me. On the whole, I think it is better to go on with the present system.

A.1916. You would rather have a paper scheme which is never filled up with students and which is always a sort of reproach. A sectional Head came before us and told the Commission that he had got two students. Is there any likelihood that the present post-graduate courses will ever be of much importance?—If these men are to fill the vacancies in the Department of Agriculture in India, I think there is.

A.1917. You point out that there are several limitations to Pusa; but, apart from the question of inaccessibility, which is obvious, there are not very many limitations to Pusa as a site for a central institute, beyond the fact that cotton, and of course to a certain extent rice, cannot be grown here?—A lot of rice is grown in the district.

A.1918. Do you think there is a site anywhere in India where one could get a farm where every crop in the country could be grown?—No.

A.1919. So, from that point of view, Pusa is no worse than others?—Pusa is no worse from that point of view. Every place will have some disadvantage; the disadvantage here is the railway communication, which is capable of improvement; it need not be as bad as it is.

A.1920. *Professor Gangulee:* Have you approached the Railway Board with regard to railway communication?—I have not; it is not my job.

A.1921. Do you know if the Institute, as an organisation, has done so?—I do not know.

A. 1922. Can you tell us the function of the Pusa Council?—It has to edit the publications and the memoirs; that is its main business; and it discusses matters of general interest, but not very often.

A.1923. Does it publish the minutes of its meetings?—That I do not know; the minutes go to the Director.

A.1924. Do you have a colloquium, where the scientific officers meet together and discuss scientific problems?—We are a small community here, and we all meet one another whenever we are not at work.

A.1925. There is no regular meeting?—I do not see the need of it. I see all my brother officers every day. It is not needed certainly where all the officers have the same social habits; it might be needed in the future, perhaps.

A.1926. With regard to post-graduate training, to which you have already made a reference, do you consider that the arrangement for post-graduate training at the Pusa Institute is a help rather than a hindrance to research?—It is no hindrance to research at all.

A.1927. Is it a help?—I think it is. I am quite glad to have these men. But I would like to say that I think a very rigid selection is necessary, that we should not take anybody who does not hold a good M.Sc. degree. Having got a man like that into a section for a couple of years, I find him useful, because his training consists in assisting in the work of the section.

A.1928. You had a number of students; could you tell the Commission the scientific qualifications of those students when they came to you?—I have had 4 since the course was instituted in its present form; 3 of them had M.Sc. degrees.

A.1929. In botany?—Yes. The fourth man was from an agricultural college; he had the highest qualification that the agricultural college could give, whatever that is; he came from the Cawnpore Agricultural College. One of these men is now in the Superior Service; another one only left us a little while back, and has not yet got any appointment; the other 2 are working in the section.

A.1930. After they receive their training under you, are you prepared to say that they are quite efficient scientific workers, and that they could tackle problems independent of any direction or any help?—They would be better, as every one would be, by being associated with somebody with wider experience during their first few years of work.

A.1931. At least they go away from here with a scientific outlook?—Yes.

A.1932. And, perhaps, with a bit of initiative?—I hope so, yes.

A.1933. Some of these men, as you say, are being appointed in the Department of Agriculture in various Provincial Governments?—One man from my section was appointed to the Sugarcane Breeding Station at Coimbatore.

A.1934. Recently, as you know, the Universities of this country have been sending out a number of students to various European countries for botanical education. Can you not develop the Pusa Institute as an institute for that sort of work, so that we can send our students to Pusa, not purely for the Agricultural Service, but for economic botany and botanical education generally?—As far as I can see, it is entirely a question of accommodation. I cannot take any more students now.

A.1935. Given the accommodation, could it be done?—Given the accommodation and the staff, it could be done, I suppose. I cannot manage any more now, I am alone in the section.

A.1936. In one word, would you like to see this Institute developed as a post-graduate college for scientific education, with a large number of students, like, for instance, the Imperial College of Agriculture in Trinidad and the Imperial College at Tokyo? Would you develop this Institute, not only for agriculture, but for higher scientific education?—No, I would not; I would keep it to its job, which is agriculture.

A.1937. Would you develop it into a Central Imperial College of Agriculture?—Yes; I should like to see all the men who are appointed to the Department of Agriculture coming from here.

A. 1938. Would you affiliate it to the University, so that you could confer degrees?—I would not affiliate it to the University.

A.1939. *The Chairman:* Not even to the extent of giving a degree on thesis?—I would prefer not to affiliate it to any University.

A.1940. *Professor Gangulee:* Do you think you could attract students to it, without having it affiliated to any University?—Given a reasonable prospect of subsequent employment, you would not have any difficulty in attracting students.

A.1941. The student gets a certain amount of training here, and he goes to Europe, to Rothamsted perhaps, or some other institute and gets his D.Sc. All the credit for his D.Sc. thesis goes to the Rothamsted Experimental Station whereas you have done the foundation work?—That is true.

A.1942. Many of our students go away from this country to European Universities to get that recognition; would you not raise the status of the Pusa Institute to that of any European post-graduate institution?—I do not think so, because we must keep the technical side of our work before us.

A.1943. With all the equipment and facilities that you have here, you would not develop this Institute in that direction?—Not for general science teaching.

A.1944. I am talking about agriculture only, post-graduate training in agriculture. Would you be content to develop this Institute into a Central Institute for the whole of India? I envisage the time when the people from the neighbouring countries will come to Pusa to study problems of semi-tropical and tropical nature?—I am afraid the development which you suggest would interfere very much with the research work and the activities of this place for the benefit of Indian agriculture. I should like to have, as I said earlier, these 3 or 4 students in the section, but the development which is being suggested would, it seems, entirely alter the character and the usefulness of this place to the agriculture of India generally.

A.1945. You would confine the activities of the Institute to the narrow limits of providing men for the Indian Agricultural Service?—Yes, but I would not exclude a man who was personally interested in agriculture, a rich landowner or anybody like him, from coming here if he wanted to do so, provided there was room for him.

A.1946. Are you in touch with the Economic Botanists of the other Provinces?—I have been in service for a number of years, and I know pretty well everybody in the service.

A.1947. When you are carrying on a piece of research work here, do you have any medium by which you can notify your provincial fellow-workers?—I can write to them, and I do write to them.

A.1948. Therefore, they are in touch with you?—When anybody that I know of in a Provincial Department of Agriculture is working on tobacco, for instance, I am in correspondence with him. I am in correspondence with anybody like that who is working on something on which I myself am engaged. Tobacco work is going on in Bengal, and the Bombay Department keeps a small farm in Gujarat for tobacco work.

A.1949. And they are in touch with you?—Yes; I visit Nadiad and Dacca regularly.

A.1950. Are you in touch with any University Professors who are teaching botany?—I used to have a certain amount of correspondence with one or two of them, but I am not very much in touch with the Universities.

A.1951. With regard to your suggestion for seed testing here, do you feel the need of a Pure Seed Act in India?—Not at present, but I think it will come in time.

A.1952. With the development of plant-breeding work, it is sure to come?—Yes; it will come in time. I do not think there is any need for it at present, because the supply of agricultural seeds is practically restricted to the Departments of Agriculture.

A.1953. Is there any arrangement here for seed testing and certification?—There is no such arrangement; I do it occasionally, when I am asked to, but it is purely a private thing, and I always do it on the understanding that no certificate of mine can ever be dragged into a legal dispute.

A.1954. *The Chairman:* What is your view of the relation between teaching and research?—I have some experience of that in England, and my view is that people who are to be trained to do research must be taught by research workers. I do not agree with the view that is sometimes put forward that we should separate research from teaching entirely. Post-graduate teaching, training of men to do research, can only be done by somebody who is doing research himself.

A.1955. What about the converse effect?—Do you think that teaching has a valuable influence upon research?—I think it has; I think if one has got students to teach, one is compelled to take an interest outside possibly the one or two lines of research which one is conducting oneself. I do not think myself that teaching, provided there is not too much of it and it is post-graduate teaching, has a bad effect upon research. Elementary teaching of course is death to research.

A.1956. *Mr. Calvert:* In continuation of what Professor Gangulee asked you, do you find that University Professors of Botany take an interest in your work?—Yes, I have had correspondence with one of them.

A.1957. Do they come and visit you and see what you are doing?—No, but we write to each other.

A.1958. What, in your opinion, should be the agency for the carrying out of work of indirect economic value, such as plants to prevent soil erosion, or reclamation of land, or things like that?—Of course, all the Economic Botanists of the Agricultural Department have become absorbed in plant-breeding. I should think that would be the work of the Forest Botanist.

A.1959. You would not make it any section of the agricultural work?—No; I would be inclined to give it to the Forest Department. There is no section of the Agricultural Department, as it exists at present, which is concerned with it. You might make a separate section, if it is considered more desirable that that work should be done by the Agricultural Department than by the Forest Department.

A.1960. You have suggested a series of bureaux; would there be any advantage in arranging them in the order of the portions of the plant, that is to say, one for the roots, one for the leaf, one for the fruit or the seed, and so on?—I do not think so. I think the scheme which I suggested for the bureaux was that each bureau should be charged with one of the major problems of Indian agriculture; I think the subjects which I suggested were soils and plant protection, and then the principal crops; that is how I should allot subjects to the bureaux.

A.1961. *Mr. Kamat:* In the scheme you suggest, you propose that the Agricultural Adviser to the Government of India should be a Member of the Assembly?—Yes.

A.1962. At present nobody prevents the Government of India from nominating him; but possibly, as the Government of India feel that they have not the power to initiate anything in the matter of the Departments of Agriculture in the Provinces, they do not think it worthwhile to do so. Unless, therefore, the Government of India, that is, the Member of the Executive Council, feels that he could do something, where is the advantage of having the Agricultural Adviser in the Assembly?—I think, considering the importance of agriculture in India, the Agricultural Service should have a permanent representative at the headquarters of the Government and he should be free to deal purely with administrative questions. He should not be concerned with being the Director at Pusa and he need not necessarily be a man of technical qualifications.

A.1963. What I was asking you was this; agricultural problems cannot possibly come up for discussion in the Assembly as they belong to a Transferred subject. What, then, would be the use of having the Agricultural Adviser in an Assembly which cannot initiate anything at all?—Do you mean that he cannot initiate any discussion in the Assembly at Delhi?

A.1964. Very little at present?—I think that is wrong; that is all that I can say.

A.1965. You think he could do something?—I do not think you are wrong in your statement; but the principle is wrong.

A.1966. But that is the actual state of affairs; and your scheme tries to change that state?—Yes; my scheme would change that.

A.1967. Then, about your suggestion to have an All-India Agricultural Association; as the members would be drawn from long distances all over the country how is this Association to function?—There would be an annual meeting of the Association and at the same time, in view of the very large distances in India, it would hold local shows in the different Provinces.

A.1968. But, according to you, the membership is open to any one who is interested in agriculture?—Certainly; we want a large non-official element in the Association.

A.1969. Therefore the membership might extend conceivably to, say, 20,000 people and would they ever meet in a general meeting?—No; a meeting of the whole Association would be an impossibility.

A. 1970. Therefore, I ask how would your All-India Agricultural Association be useful to the country?—It will have to be sub-divided.

A.1971. Into provincial associations?—It might perhaps not be advisable to sub-divide it in accordance with the existing provincial boundaries; but it will have to be sub-divided.

A.1972. Your aim is to secure advice on agricultural problems?—My aim is to create a sort of public spirit and interest in agricultural research and progress in India. That is what I think such an Association might possibly do.

A.1973. It will not be of any use in solving agricultural questions, or in showing the agricultural needs and requirements of the public. In that respect it might fail. Suppose the public want a solution of a particular agricultural problem. If this Association never meets at all as a body as a whole, how would you obtain the lead from the non-official members?—It could very well be met by delegates.

A.1974. Then it comes to this, that it would have to resolve itself into committees?—Yes; you would have to have committees certainly.

A.1975. Do you think that would be a feasible arrangement?—I think so. I do not see any other way of doing it.

A.1976. *Sir Henry Lawrence:* You referred to some Devolution or Departmental Rules and said that they were a handicap to you in doing the necessary touring. Will you refer me to the particular rule you mentioned? —This is the rule which was communicated to me by the Agricultural Adviser to the Government of India: 'It is the accepted principle of the Government of India and the local Governments that whenever an extra expenditure is actually incurred by the Central Government on account of the services rendered to Provincial Governments by one of its officers, a claim for it can be raised on the Provincial Government, and *vice versa*. Acting upon this principle, the Audit Deparmtent insists on claims being made on Provincial Governments for any expenditure incurred by the officers of this department in undertaking any work or tour at the special request of provincial departments. If you so desire it you may make use of this information in your reply to the Questionnaire of the Royal Commission on Agriculture.'

A.1977. *Sir Ganga Ram:* Is that a departmental rule or a Devolution Rule?—It is not a departmental rule.

A.1978. *Sir Henry Lawrence:* There is no mention of a Devolution Rule in this statement?—No. I think we should be allowed to tour for the purpose of consultation with another officer of another department who is engaged on the same line of work.

A.1979. *Sir Ganga Ram:* On invitation or on your own initiative?—One would naturally write to the man who is engaged on the same line of work as one's self, and suggest that it would be desirable to meet for the purpose of discussing and working together. If an officer at Pusa were to put up, as a reason for going on tour, the fact that he wished to discuss his work and its possible line of further development with another officer engaged on the same line of work, I do not think that tour would be sanctioned. Touring for the purpose of consultation with another officer engaged in the same line of work would not be sanctioned.

A.1980. *Sir Henry Lawrence:* But you are not debarred by any Devolution Rule that you are aware of?—I do not know the Devolution Rules.

A.1981. They can only be altered by the Government of India and the Secretary of State?—I understood that these rules which prohibit us to a certain extent were Devolution Rules. I must say I have never read the Devolution Rules and I do not suppose I ever shall.

A.1982. This order merely refers to a ruling of the Audit Department?—I think the Audit Department acts on the Devolution Rules.

A.1983. *Sir Ganga Ram:* Do you see any possibility of breeding wheat seed to suit the soil of Bombay and Madras in place of *cholam, bajri* and other winter crops?—I am afraid I do not at present.

A.1984. You do not see any possibility of it?—Not of extending the cultivation of wheat into the tropical areas of Madras and Bombay.

A.1985. Has any research been made about it?—I do not think so.

A.1986. You think it is not possible?—I should think it would be impossible.

A.1987. But do not you accept the American principle that if the soil does not suit the seed a seed must be discovered to suit the soil?—Certainly.

A.1988. Then why do you call it impossible?—There are limits to that. For instance, I do not think it would be possible to produce a variety of paddy which would grow in Scotland.

A.1989. I want to ask you specially about wheat. You think there is no possibility of introducing wheat in the place of *cholam, bajri, ragi* and others in these two Provinces?—I think that the temperature in these areas would render it impossible; that is my opinion.

A.1990. Have you any experience of dry farming?—No.

A.1991. Have you visited any such place in America?—No.

A.1992. Do you think that the quantity of water has an effect on the yield of a crop?—In my experience in Pusa it has a very big effect.

A.1993. You mean the greater the quantity of water you use the more the yield?—We do not irrigate here.

A.1994. Say, in irrigated tracts; have you made any research on that subject?—I have had no experience of irrigation at all.

A.1995. I do not remember seeing it in the *Agricultural Journal;* but did you read the account of Mr. Howard making experiments in my village, Gangapur?—I have the file in my office.

A.1996. With two waterings, where they generally give four waterings, he produced a 25 per cent greater yield of wheat; that, I think, was due to harrowing. What do you attribute the success to? Do you think the real reason is that it is due to harrowing?—I should not like to give an opinion on that, because I have not seen it. I was not concerned with the experiment itself at all.

A.1997. Do you know that 140 inches of water is given for sugarcane? Is that a good practice?—I am afraid you are getting me off my subject. I do not know about irrigation.

A.1998. *Sir Thomas Middleton:* You mentioned that in putting up certain proposals (specifically in the case of tobacco cultivation) you submitted them to the Director?—Yes.

A.1999. That is, I presume, mainly for budgeting purposes, it is quite necessary that the Director should know what money you are likely to need?—It is also with a view to preventing overlapping and with a view to co-ordination of work between the different sections. It is not a rule which is very strictly observed, I think.

A. 2000. I should suppose it would be necessary to bring to the notice of the Director any such proposal which is likely to add considerably to the cost of your work?—Most certainly.

A.2001. Otherwise the work of each section is practically independent? Each Head of the department is working independently?—Yes.

A.2002. So that Pusa really represents a group of research institutes in the sense in which we use the term 'research institute' in Britain?—No. I think that is taking an extreme view of the case because, as I mentioned earlier in my evidence here, we are alone in a small place. We are all together every minute of our lives and there is nothing to talk about except our work. That is the saving thing with regard to the point which you are raising now.

A.2003. For example, your plant-breeding work here represents work which is being done at Cambridge, Edinburgh and Aberystwyth?—Yes, from that point of view. I misunderstood you.

A.2004. Similarly with regard to the work in the Chemical Department? —Yes.

A.2005. You have insisted in your evidence on the need for more frequent meetings between research workers?—Yes.

A.2006. You propose to secure that object by organising the work in bureaux?—Yes.

A.2007. The distances in India are very great, and the difficulty of getting gatherings of considerable size is also great. Do you not think if you had these eight stereotyped bureaux, it might prevent research workers meeting as frequently as they ought, rather than have the effect of bringing them together?—I cannot say that that point of view had occurred to me.

A.2008. I ask for this reason; we have a Research Council, as you know, in Britain; we are organised more or less on the lines of your bureaux; we did think at one time of arranging meetings of the separate groups, but we found that in fact the interests were so numerous that much more frequent meetings could be arranged if a few workers who were engaged on a specific point were empowered to meet as and when the necessity arose; that is how we solved the difficulty?—Yes; I do not see that that is fundamentally opposed to what I have put forward in my note.

A.2009. It is not fundamentally opposed, the object is the same?—Yes.

A.2010. But the effect of organising by bureaux might be to prevent the very object you have in view; at least, this is what we have found in our experience. The fact is that the more you attempt to classify on paper the subjects on which agricultural research workers are engaged, the more difficult it becomes to arrange for frequent meetings?—Yes, certainly.

A.2011. Your whole object would be secured if by some means it was understood that workers would meet frequently and their expenses could be met?—That would go very far towards securing what is my object in this note, certainly.

A.2012. In connection with the training of Indian students you referred to some disabilities under which they labour. One is the obvious one that French and German are not languages that are taught in the schools, and you think special measures should be taken to overcome that difficulty?—Yes; at the last meeting of the Pusa Council we discussed that point and the possibility of obtaining a tutor in French and German. At the present moment in my own section I try to give a little instruction in German to my students.

A.2013. But the more serious difficulty seems to be the lack of grounding in mathematics, physics and chemistry?—Yes, that is the more serious difficulty.

A.2014. There would appear to be no inherent reason why that particular difficulty should not be removed?—No, there is no reason why that should not be removed, but we cannot do anything to remove it here. We can do something with regard to French and German.

A.2015. You are pointing out that the training is defective?—That is the defect in the Indian University training as far as the students who come to us are concerned.

A.2016. In answer to Prof. Gangulee you said you would rather not have any association with a University; do you not think it would greatly add to the attraction of Pusa from the students' point of view if they were able to take a degree as the result of their study here?—I am afraid of that sort of thing interfering with the research work of economic value which we have to do. You see a good many of our investigations are of a kind on which I do not think a University would give a degree.

A.2017. I ask for this reason; we have at the present time, I suppose, 20 or 30 research students in training in Britain in connection with agricultural work, and of those who go to Cambridge I suppose quite half will take a degree while they are pursuing post-graduate studies; from the student's point of view the possibility of qualifying for a degree certainly adds to the attraction of the post-graduate course. So far as I have heard, there has been no difficulty raised from the standpoint of the institutions?—I was speaking purely of my own section. My section is more difficult from that point of view than any other, because our work is on plant-breeding, as you know, and a problem in plant-breeding takes a long time to complete. It is very much more feasible in some of the other sections.

A.2018. We have the difficulty which you indicate in plant-breeding, but you have the advantage over the British plant-breeders that you can put through two or more crops in a season?—Yes.

A.2019. In Britain we have one crop in a year to deal with and therefore it is not a very suitable subject for a research degree?—Yes. I might give you an instance from the work going on now in the section. In the cold weather of 1924 or 1925 one of my students took up some cross-breeding work in gram; that particular student only got as far as the first hybrid generation in the next year. The present lot of students are carrying on that work but they will not finish it. I should think three generations of students will have passed through before that work can be published.

A.2020. That applies to your own section; not necessarily to other sections?—It does not apply to other sections to the extent to which it does to mine.

A. 2021. *Professor Gangulee:* But even in your own section students could undertake certain research dealing with plant-breeding. Take, for instance, the morphological character of *arhar* flowers; one of your students could undertake that problem and see what relation exists between the morphological structure of that flower and immunity of the plant from diseases?—Yes.

A.2022. You will agree with me that that is a problem which could be undertaken by a post-graduate student, and it is a suitable subject for a thesis?—Yes, provided he is going to stay there for four years; four successive seasons I should think would be required before you would be absolutely certain which way the resistance to disease was going with a particular morphological character. We have now had two seasons and I think we want two more.

A.2023. *Sir Thomas Middleton:* But, from what you have already said, I think you would agree that so far as the giving of instruction in plant-breeding is concerned, you are more favourably situated under Indian conditions than you would be in a temperate climate?—Yes, I think so.

A.2024. You have a wider range of crops and a more rapid growing season?—That is why I consider we are likely to get better results by training men here for the Agricultural Service than by sending them to Europe.

A.2025. *Dr. Hyder:* Are these students whom you are training here in receipt of scholarships, or are they probationers?—I will answer that question afterwards if I may. Some have scholarships and some pay their own way; I really could not tell you how many off-hand.

A.2026. *Sir James MacKenna:* There are no scholarships given by Pusa? —I do not think so.

A.2027. *Dr. Hyder:* With regard to your being linked up with other officers working in the Provinces, would it suit you if you had an opposite number, say with regard to botany, in all the Provinces, and your correspondence were officially recognised?—I am able to correspond with them now.

A.2028. But you are not able to meet them?—I do not say I have so much difficulty in meeting them as they have in meeting one another. You see I can, subject to certain limitations, tour all India, but the man, for example, who is working on tobacco in the tobacco farm at Bombay cannot very well go to the tobacco farm at Dacca.

A.2029. So that the chief thing is to bring these men together?—I think so.

A.2030. Under you? Is that the idea?—I do not necessarily wish to put myself at the head of a hierarchy of Economic Botanists.

A.2031. With regard to this question of post-graduate teaching I am going to read to you a Resolution of the Imperial Conference of 1926, and I will ask you whether you agree with the principles laid down there, " The first requisite in a candidate for scientific service is a thorough grounding in science in its broadest aspects; it is only on the basis of such a training as is given by a well-conceived honours course in science at a University that a superstructure of specialised training can be soundly built "?—I agree with all that.

A.2032. " The sub-committee welcome the increasing importance which Universities are attaching to research and the tendency to emphasise the essential connection between higher teaching and research work." Do you agree with that?—I agree with that, certainly.

A.2033. Where does Pusa come in here?—I think we do both the higher teaching and the research work.

A.2034. On a sufficiently large scale?—About 90 memoirs of a botanical series of the Department of Agriculture in India have been published. Of these about 50 have been written by officers working in the laboratories at Pusa.

A.2035. You say officers; do you mean students?—No, I mean officers of the Indian Agricultural Service.

A.2036. But we want more memoirs from the students?—Yes.

A.2037. I mean this has a bearing on the training of students?—Yes.

A.2038. The members of the Agricultural Service are quite capable of looking after themselves, but what would happen if you all disappeared?—I do not quite follow your question. Do you mean that the post-graduate students here should have more chance of publishing work?

A.2039. Yes?—As I have just endeavoured to explain to another member of the Commission, in my own particular subject it is almost impossible for a man who comes for a two years' course to carry through a line of work to a point at which he can publish it. When the particular example which I mentioned just now is published I shall edit it as a joint effort of all the men who have been engaged on the work. In my own particular subject I do not see how a man can publish a piece of work which is his own in the two years that he is with us.

A.2040. The Resolution already referred to says further, " Specialised study necessary for scientific officers should be mainly of a post-graduate nature." Is that right?—I do not see how it can be anything else.

A.2021. And again, "In accordance with the usual practice of Universities such specialised study should be taken under men who are engaged in research in the fields concerned." Now I put you this question: If we sent men from the Indian Universities to you who had a good grounding in these subsidiary subjects, would you like to take these men to train under yourself?—In what capacity?

A.2042. As post-graduate students of the section?—But surely that is what we are doing now. I take my post-graduate students from Indian Universities. I take men who have already taken an M.Sc. degree, if possible. Is that not what you mean?

A.2043. I meant that, but you take only two men. Can you not take more?—I have not the room for more.

A.2044. If you were given more accommodation and equipment?—Yes, if we were given more accommodation and a larger staff, instead of taking only 2 a year we might take 4. But I should not care to take more than 4 because I should not feel that I could give my personal attention to more than that number.

A.2045. As regards representation in the Assembly, this matter has come up not only in your evidence but also in the evidence of another gentleman. Do you know that an official member in the Assembly, unless he happens to be a Member of the Viceroy's Council, has got to leave his ideas and opinions outside the door? He has simply got to sit and vote quietly. That is what an official member does?—That is highly regrettable indeed.

A.2046. *Sir Ganga Ram:* Do these post-graduate students, who come to you, come with an eye to getting Government service or do any of them come with a view to starting work on their own? Do you get these students from the talukdar and big landlord communities?—No; that I think is one of the most serious difficulties. Practically every student who comes to us comes with the idea of getting subsequent employment under Government and what, in my opinion, is needed in India is that the big Indian landowners should be more inclined to send their sons for training in agriculture.

A.2047. That has not been done yet in the case of talukdars and such like people?—No application has yet been made to me by a man who would not at the end of his course have accepted a Government post, had it been offered to him. One of the students I have got at present in the section has a certain amount of landed property, but he would certainly take up a post in the Superior Service if it were offered to him. I do not think that I have had anybody coming to me for training with the deliberate idea of returning to the parental estate and increasing the outturn of his home farm.

A. 2048. *Professor Gangulee:* Would you express your views on the working of the Board of Agriculture?—The Board of Agriculture has not been, in past years, of very great interest to scientific officers of the Indian Agricultural Service because its constitution is such that it is scarcely possible to discuss technical problems such as scientific officers have to deal with. The Board of Agriculture has been concerned more with administrative questions and, very largely, with questions about cattle. As far as I am personally concerned, in recent years the Board of Agriculture meetings have been rather dull. That is all I can say.

A.2049. Do you think it can be revived and made a very useful institution?—No. I think the Board of Agriculture would always find its time taken up with discussions of an administrative nature. It is not a suitable body for the discussion of scientific questions.

A.2050. Would you like to revive the Sectional Conferences?—I should like to revive the same sort of things as meetings of these bureaux which I have suggested. I think that is a more profitable line.

A.2051. *Sir Thomas Middleton:* Assuming that in the future a demand were to arise for post-graduate training in your subject, do we understand that the limit of 4 students which you have mentioned is due to the lack of teachers and of laboratory accommodation, and that there is no limit imposed by the facilities which the natural conditions of Pusa offer, or by the problems which remain to be tackled?—There is a limit by the natural conditions which Pusa offers. In stating that the maximum number that I could take would be 4, I was supposing that the botanical area which you have visited this morning is to remain the sole area available for my work. Given increased laboratory accommodation and an extra staff I should take about 4 students a year. If you go beyond that, you have got to give me more land, that was the point.

(The witness withdrew.)

Dr. W. McRAE, M.A., D.Sc., Officiating Imperial Mycologist, Pusa.

Replies to the Questionnaire.

QUESTION.—1 (a) (i) The Central Government will always be deeply interested in agriculture which is the main employment of the great majority of the people of India. Some of the activities of the Central Government towards the improvement of agriculture are being carried out directly in the Agricultural Research Institute at Pusa, the Imperial Institute of Dairying at Bangalore and the dairy farms at Karnal and Wellington and indirectly by the levy of cesses on exported cotton and tea in order to provide funds for the Central Cotton Committee and the Indian Tea Association to further the many interests connected with those two crops. If Government would levy a small cess on the other main exports of agricultural produce such as food grains, oil-seeds, fibres, tobacco, coffee, rubber, spices and manures, an income sufficiently large would be secured to enable Government to finance operations to further agricultural improvement in its widest sense to an extent commensurate with the need.

For the administration of such a fund an Advisory Board might be set up representative of the various interests. It would consist of members representing the Departments of Agriculture in British India and the Indian States, members for local agricultural interests and for trade and manufacturing interests. It would be an All-India body. Its function would be to initiate and encourage research, experiment and demonstration, to examine schemes of work and to allocate the necessary funds to carry them out. The organisation is intended to supplement the work being done by Departments of Agriculture in the Provinces and States. It is in no way meant to relieve Provinces of work they should and can do; it is meant to help where help is required. Permanent secretaries would be required who might divide the activities somewhat as follows: (1) crop-production and improvement, (2) animal husbandry, dairying and fodder-crops, (3) finance, economics and co-operation, (4) irrigation and engineering, and (5) crop protection.

The secretary in charge of crop protection would deal with plant diseases, insect attacks and the destruction of crops by wild animals. An example may be taken as to how such an organisation would function with respect to a disease. After considerable observation it has become established that mosaic disease of sugarcane exists in several varieties of cane in certain centres in most of the Provinces of India, *e.g.*, the Punjab, the United Provinces, Bihar, Bengal, Assam, Bombay and Madras both on thick and on thin canes. The disease is widespread in position but its extent is not yet known definitely. The immediate problems that need elucidation are (1) what is the extent of the disease in the various cane growing regions, (2) what loss does it cause, if any, and (3) how is it spread and to what extent.

The requisite information about the first point can be found best for each Province by the staff in that Province. The other two points should be worked out jointly by the staff in the Imperial Department and those in the Provinces and States. Adequate experiments to find the possible loss will have to be done in tropical India on thick canes and in Northern India on thin canes. At present experiments are being done on thick canes at Coimbatore and on thin canes in Pusa but what is being done in other Provinces is not yet known. A definite co-ordinated set of field experiments is required in various parts of India by several workers. Unnecessary duplication along some lines of work due to ignorance of what is being done elsewhere would be eliminated and necessary duplication along other lines would be properly provided for. Much laboratory work has also to be arranged according to the skill and interest of the several workers and the facilities available or capable of being provided and money may be required to finance these activities.

The Advisory Board would form a committee of Entomologists, Plant Pathologists and Agriculturists taking care to see that the fullest contact was made with all the interests concerned. The committee would formulate a scheme of work; see what staff was available in the Provincial, State, and Imperial Departments, allocate the problems amongst them and estimate what amount would be required of the Advisory Board's funds to supplement what could be provided by the Provinces and States. The report would be approved or modified as the case might be by the Advisory Board which would allocate the necessary funds or as much as was available. The members of the committee would carry out the parts of the scheme allocated to them and report progress periodically as might be arranged to the secretary for crop protection who would keep each individual of the committee and other persons interested informed of the progress of the work. Meetings of the committee would be arranged when necessary. Each individual worker would be responsible for writing up his own work for which he would get due credit in publication and the compilation of the final report would be the duty of the secretary for plant protection. With such a scheme Directors of Agriculture in Provinces and States and all persons interested in disease problems would know exactly where to go for information, as to what had been done and as to the progress of work being done and, what would be an inestimable boon, could make arrangements for being supplied with information from time to time as it became available. The responsibility for the means for bringing to the notice of cane growers whatever methods or measures have been worked out for the amelioration of the effects of disease usually falls on the local Agricultural Departments who might be helped in certain circumstances as required.

The scheme depends entirely on the provision of an adequate fund to be placed at the disposal of the Advisory Board. Advice backed by financial help will always be eagerly sought after but without the financial lever the advice of such a Board would not, I think, receive the consideration due to it.

(*b*) Work awaiting funds:

(1) Study of soil fungi. The soil is not simply a congeries of particles packed together more or less firmly but it is teeming with various organisms that have a beneficial or a detrimental influence on the plants growing in it. The rôle of bacteria in the soil has been investigated to some extent and a considerable volume of helpful knowledge is at the disposal of the agriculturist. That certain fungi work on the organic and inorganic matter in the soil to make it available as plant food there seems to be little doubt, but this subject remains still to be studied in India. Some harmful fungi in the soil such as members of the genera *Fusarium*, *Pythium* and *Rhizoctonia* have been studied to some extent because they attack the crop itself but much remains to be done on this whole subject which is of economic importance.

(2) Study of sugarcane diseases. So important has this subject become that a special staff would find full employment for a considerable number of years. The new canes bred at Coimbatore have opened up possibilities of disease resistance that would repay consideration.

(3) Study of fungi parasitic on the rice plant. Many fungi are found parasitic on paddy in certain circumstances. Occasionally one of them causes appreciable loss in restricted areas. Such a case was the outbreak of *Piricularia* in the Papanasam taluk of the Tanjore district in South India in 1917. Great damage was caused over 1,700 acres but next year fortunately the disease was absent. Though the necessity is not immediate, I think a mycologist should take up the investigation of the fungi on paddy as a form of insurance. If ever a disease became epidemic on paddy and could not be restricted, the loss

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would be too appalling to contemplate. We should, accordingly, be prepared with a full knowledge of what fungi are present and of the reactions of the plant to them.

(4) Diseases of cereals require far more intensive study than they have had so far in India, *e.g.*, the life-histories of some of the smuts on *bajra* (*Pennisetum typhoideum*), *juar* (*Andropogon sorghum*), *Kodra* (*Paspalum scrobiculatum*), *sawan* (*Panicum frumentaceum*) and rice are not fully known.

(5) Diseases of vegetables have been touched very slightly.

(6) The virus group of diseases of which mosaic is an example has received little or no attention but the problem has become urgent on sugarcane.

QUESTION 2 (*xi*).—A two years' course in plant pathology is provided and two students each year can be taken. Students who have a science degree of an Indian or foreign University or a degree of an agricultural college in India are eligible. Those who have done well in botany are chosen. Plant pathology is not usually taught in colleges and Universities as such so that post-graduate students taking the course know only such examples of the main groups of fungi as come within the course in botany. What is essential besides the knowledge and the training that the subjects of a degree course provide is a good knowledge of plant anatomy and plant physiology and where that is present there is no inherent difficulty in giving the requisite training in plant pathology within the time to fit a student for a post in a mycological laboratory so that he can take up research work. During the two years, however, most of a student's time is taken up in acquiring knowledge of facts and methods and only simple problems in investigation can be undertaken. Provided a student has a good scientific education and has the spirit of investigation the course is sufficient to train him to the point where he can begin research work himself. Men who undergo the post-graduate course in mycology look for employment in two directions, to the Universities as lecturers in botany and mycology and to the Departments of Agriculture. The present method of recruitment is suitable for the first but does not adequately meet the needs of the latter. It would be preferable for Directors of Agriculture or whoever be the recruiting authority for the Province to choose from among the diplomats of the agricultural colleges or graduates of the Universities or others the men they wish trained in this subject for their Provinces. Such men would be training for a definite post and would not be hampered by uncertainty as to their future and the fear of unemployment. After passing through the course they should have a few years service in their departments and if their work justified expectation they should be sent to a foreign college for a year or more according to circumstances to undertake a definite line of study. They would go with a personal knowledge of the work they had to do in their own localities and with a mature mind capable of estimating new methods, of appreciating new points of view and of measuring themselves with their fellow-workers. The cost would be well repaid by their increased value as investigators in the realm of plant pathology.

Seeing that the standard systematic work in mycology, Saccardo's "Sylloge Fungorum," is written in Latin and that much of the best work along certain lines is written in German and French, a knowledge of these languages should be considered a necessary part of the mental equipment of a mycologist. A language teacher ought to be appointed to the staff at Pusa for the benefit of post-graduate students and tuition in these languages ought to be part of the training. Students in other subjects than mycology would be benefited equally. The students in my section at present endeavour to learn to read descriptions of fungi in Latin and German but the time at my disposal to help them is so limited that a special teacher for the purpose is really required.

Considerable benefit would accrue to the Research Institute if a whole-time Director were appointed. At present the Director, being also Agricultural Adviser whose duties and responsibilities outside the Research Institute have increased very considerably in recent years, has only a part of his time to devote to the Institute and is away from Pusa for a considerable period each year. The Joint Director is immersed in the minutiæ of administration and being also Head of a Section has not the time nor the authority to devote to general questions that affect the sections. Besides a whole-time Director, I feel sure, would relieve research officers of much administrative work of a routine nature that at present dissipates their energies and leads to much waste of time and sometimes to a loss of keenness. The present organisation is at best a make-shift brought about for reasons of economy which have now disappeared.

QUESTION 13 (*i*).—A paper on the "Dissemination of Parasitic Fungi and Internal Legislation" by Dr. E. J. Butler discusses the methods by which fungi that cause plant diseases spread over comparatively short distances as from Province to Province or State to contiguous State and also over long distances as from continent to continent or State to State separated by a wide ocean or very high mountains. The spread of plant diseases is brought about by the transference of spores and *mycelium* by means of the wind, water, animals, insects and man. The *mycelium* of a parasitic fungus does not as a rule live long in the absence of the plant on which it grows and is thus of comparatively little significance as transferable infective material by the agents mentioned except man. Spores, produced usually in enormous numbers in exposed positions, are the main materials disseminated. All the agents can transfer spores for short distances but only birds, insects, wind and man can carry them long distances.

Long distance or discontinuous spread may be considered first. Migratory birds and insects sometimes travel very long distances and spores have been found in large numbers on parts of their bodies. Particles of dust comparable in size to that of spores have been blown for thousands of miles after being carried into the upper air by volcanic outbursts and violent storms. It is natural to expect that spores would be carried in this way too. Were this so, the diseases which they cause would be world wide. But a consideration of the distribution of the better known plant diseases does not justify this supposition. The evidence is circumstantial but it is so substantial in volume that we may take it as a workable proposition that infection by spores carried through the air from remote countries is not a contingency that need be taken seriously into account.

There is abundant evidence, however, to show that many plant diseases at first confined to limited areas have, owing to the activities of man in transporting seed and living plants over long distances, been carried to regions in which they did not previously exist. Examples are the black rust of wheat, the late blight of potatoes and the leaf-disease of coffee, which have followed their respective host plants into most countries into which they have been introduced as a crop, and the mosaic disease of sugarcane once confined to the eastern tropics now occurs in almost all cane-growing countries. Nearly every introduced crop in India has one at least of the diseases to which it is subject in the country from which it came. Some years ago a case occurred in Coimbatore when a small parcel of sugarcane setts from abroad arrived at the Cane Breeding Station with pineapple disease which does not occur in Coimbatore nor has it been found anywhere in India.

In early days, when means of communication were scanty and voyages long, the discontinuous spread of plant diseases was slow but at the present day steam has speeded up communications to such an extent that almost every region of the world has been brought so close that parasitic fungi can live during the time required to traverse the intervening distances and as soon as airships become an established means of communication the last deterrent in time and space will have vanished.

Parasitic fungi, then, travel in association with their host plants but, as the fungi themselves cannot be effectively dealt with directly and in many cases cannot be detected by an examination at the port of entry, the remedy lies in the proper control of the importation of the host plants with a view to see that the plants come in free from disease. Fortunately India is geographically particularly well situated from the point of view of controlling imports. On the north the Himalayas are practically impenetrable and the other boundaries are ocean girt. Only through Baluchistan, and the eastern boundaries of Burma is access available by the continuous spread of fungi. Across the narrow strait from Ceylon, too, it is possible to receive infective material but Ceylon has a well administered Pest Act, so India is protected quite effectively in that direction.

In 1914 the Government of India passed the Destructive Insects and Pests Act and subsequently made several notifications under that Act.

In forming the list of diseases to be guarded against one has to take into consideration (1) the destructive diseases likely to be imported, (2) the fact that the degree of destructiveness in one country is no certain indication as to the possible virulence when a disease is introduced into another country and (3) the fact that too exhaustive a list would be irksome and hampering to trade. The first consideration is dependent on our knowledge of diseases in other countries. The most destructive diseases are known in most progressive countries but a great deal has to be done in every country and especially in countries where scientific methods are hardly yet applied to increase the knowledge of parasitic fungi especially on economic plants. It is such diseases that have been listed in the notifications because we fear they will be destructive in India. To meet the possibility of a disease of little account in another country being destructive in this country there is no provision in the notifications for we have no criteria by which to judge which are the likely ones and they could only be guarded against by the total prohibition of imports of all living plants, an ideal position which India is not ready for yet, though fortunately she is even now to a large extent self-contained in the way of most crops and important nursery stock of an economic value. The list of diseases is a modest one and the application of the measures of the Act cannot be said with the least degree of truth to be hampering to trade. Briefly the items are:—

Potatoes against wart disease.
Hevea rubber plants against *Fomes semitostus*.
,, *Sphaerostilbe repens*.
,, *Fusicladium macrosporum*.
Sugarcane ,, Root-diseases.
,, Pine-apple disease.
,, *Sereh*.
,, *Gummosis*.
,, Mosaic.
,, Fiji disease.

Coffee and *Hevea* to be imported from America only by the Madras Agricultural Department.

The strategy of the Act is to tackle the disease beyond the frontier by seeing that plants are free from specified diseases when they start on their journey to India. Dependence is placed on a certificate from a phytopathological institute supplemented in the case of potatoes by the consignor's certificate. In the case of coffee and *Hevea* rubber an additional safeguard is provided by having the certificated plants come to a definite agency in India (the Madras Agricultural Department). While in the case of Fiji disease of sugarcane resort is had to total prohibition from the countries in which the disease is known to exist.

As in all preventive measures, it is difficult to get direct evidence on which to form an opinion as to the efficacy of the Act, but it is significant that the diseases listed have not come into India though imports of all the host plants have been made since 1914 when the Act came into force.

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The officials whose duty it is to see that the regulations are complied with are the customs officers at the various ports. So long as they act literally, make no exceptions and fearlessly refuse entry to consignments not fulfilling the regulations then the Act is being efficiently administered. In the declaration form given to passengers on entering an Indian port for the purpose of customs duty no mention is made of the restrictions on the import of seeds and living plants and this is a possible means by which a parasitic fungus might evade detection because of the lack of knowledge of a passenger. A note in the declaration form would be useful.

Certain scientific officers are by notification granted some specified exceptions to the restrictive provisions and this is safe as each officer has available both mycological and entomological advice but any other exception not granted by notifications is a source of danger. For example certain potato growing districts in Bombay are dependent on the annual importation of Italian " seed ". This seed was by notification granted exemption from the production of the consignor's certificate that the plants were not grown within five miles of an infected field. Last year suddenly a consignment of potato seed from Germany was landed in Bombay without a certificate and exempted by an order of a secretary to Government. Germany is one of the countries badly infected with wart disease the one against which protection is sought. Thus it has come about that the provisions of the notification have become nugatory and afford no protection against wart disease of potatoes. Only by notification should any modification be made and no exception should ever be given that is not actually mentioned in the notification.

(*ii*) The continuous spread of plant diseases within a country or a continent is quite a different matter. Here all the agents of dissemination play a part in spreading infective material for shorter or longer distances and season by season extend the area affected and most of the agents are at best only partially controllable.

With the more accurate knowledge of the cause and the progress of disease many methods have been devised to meet the need for combating the multitude of diseases to which plants are subject. Some of the more important are enumerated. It is of course just a list of methods not by any means exhaustive and very often more than one of these methods is adopted against any one disease.

1. Killing the causal organism on or in the plant, *e.g.*, steeping seed of *Sorghum vulgare* in a 2 per cent solution of copper sulphate against smut and exposing potatoes to a temperature of 80° F. to kill the *mycelium of phytophthora incestans* that causes late blight of potatoes.
2. Cutting off affected parts of a plant, *e.g.*, pruning *Hevea* rubber against pink disease, coffee against *die back*, fruit trees against various stem and branch diseases.
3. Uprooting and removing affected plants, *e.g.*, rogueing potatoes against wilt, sugarcane against mosaic.
4. Using protective sprays or dusts, (*a*) applied to the plants, *e.g.*, spraying coffee with Bordeaux mixture against leaf-disease, spraying *Hevea* rubber with Bordeaux mixture against second leaf-fall, spraying vines with Bordeaux mixture against mildew, spraying arecanuts with Bordeaux mixture against *mahali* disease, dusting grapes with sulphur against powderly mildew, dusting seed of *Sorghum vulgare* against smut, steeping wheat seed against smut, painting cleaned wounds of trees against several diseases such as coconut palm against bleeding disease; (*b*) applied to the environment, *e.g.*, soil sterilisation with formaline against damping-off of tobacco seedlings, sterilisation of implements as knives in the operations against bud-rot of palms and flowers, bags, etc., after steeping seed.

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5. Avoiding susceptible varieties and using resistant varieties, *e.g.*, Pusa 4 wheat in the North-West Frontier Province because it is resistant to rust and stands up to the wind, changing from *shaftal* to *berseem* as a fodder because the latter is liable to an epidemic leaf-disease, substituting Bombay gram for Burma gram to avoid wilt, substituting exotic varieties of ground-nut (from the United States, Japan, Mauritius, etc.) to escape *tikka* disease.
6. Practising crop rotation in order to starve soil fungi such as *Fusarium* and *Rhizoctonia.*
7. Avoidance of disease bearing material as in selecting setts of sugar-cane for planting.
8. Avoiding manure on which diseased plants have been thrown especially with regard to garden crops.
9. Avoidance of disease infected localities, when getting seed or new stock.

Self-interest makes the grower attend to the various methods enumerated except perhaps in the last cases where he may not be so careful to safeguard his neighbour's interests. There, in very special cases, legislation would be beneficial:

(1) in legalising a campaign against a disease with a view to confine it within limits,

(2) in suddenly providing measures for dealing expeditiously and drastically with a newly imported disease,

(3) in stopping the movements of possibly infected plant material out of a badly infected area or into a disease-free region.

The campaign against the bud-rot of palmyra palms in the Godavari, Kistna and Guntur districts has been carried on for nineteen years. In 1908 the death rate was 80,000 per annum, in 1920 it was 8,000 but in 1925 it was 17,000. The disease has not been eradicated and it is an example of the extraordinary difficulty of suppressing a disease once it has a good hold. What has been done is to reduce the magnitude of the loss and to restrict the spread.

The second benefit would be had if a disease like that of wart disease of potatoes got into India. Nothing but prompt measures carried out drastically would give any hope of success.

The third possible use of legislation is very limited and would be applicable in only a few special diseases that were carried almost exclusively on the plant parts and not by spores and where the locality to be protected or defended against was peculiarly isolated. Madras is the only Province in India that has a Pest Act but I think each Province should consider whether it should have the legislation to enable these measures to be carried out if they became necessary. Celerity being an important factor in the initiation of the operations it would take too long to assume powers after the necessity arose. Within the borders of India legislation as a means of plant protection is of very restricted value. The study of the fundamental problems of diseases in relation to their host plants and the environment, the working out of all possible methods of attack or defence and above all teaching the cultivator that the losses from disease in his crops are preventible and that the means are within his powers is the true way of dealing with diseases that are already within our borders.

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Oral Evidence.

A.2052. *The Chairman:* Dr. McRae, you are Officiating Imperial Mycologist?—Yes.

A.2053. We have your note of evidence before us. Do you want to say anything of a general character at this stage?—No.

A.2054. Your note is very full and I have really very few questions which I wish to ask you. I think that we should like to hear about your own training and past appointments?—I got the M.A. degree and subsequently the B.Sc. degree at Edinburgh University. After the final B.Sc. examination, Professor Farmer asked me to become his Demonstrator in Botany in the Royal College of Science, London. I was there for two years, when I got the appointment of Supernumerary Mycologist at Pusa. I went to Germany for 7 months, most of which time was spent at Munich where I studied plant diseases in Professor Freiher von Tubeuf's Laboratory. I was in Pusa for a year and 9 months as Supernumerary Mycologist, then I went to Coimbatore as Government Mycologist for Madras. In the last year and a half of my stay in Coimbatore I acted as Principal of the College; I was transferred to Pusa in 1920, since when I have been here.

A.2055. Do you think that this site at Pusa is one which is suited for the work which is being carried on in the institution?—Mycologically, it is suitable. There is only the difficulty of its position; certainly a site south of the river, on the main line, would be more convenient both for us and for visitors. But so far as my work is concerned it is rather a good place. It is intermediate between the Western belt and the Eastern belt and we can grow the crops of both sides with the result that I have command of a large number of crops on which to study diseases.

A.2056. Are you satisfied with the degree of co-ordination between section and section?—Yes. We meet continually. Whenever something goes wrong with the agricultural side of my work, with the field experiments, I go at once to the Agriculturist and he comes to my assistance. When I have got to carry out a field experiment I go to the Agriculturist beforehand, consult him and arrange with him as to when and where the field experiment can be done. The same is the case with the Botanist, the Chemist and the other Heads of Sections. So that, whenever I want help, I have no difficulty in getting it, likewise I am equally ready and willing to help the others.

A.2057. How about initiating new directions of research? Is the officer in charge of a particular section left to himself in that matter?—To a very great extent he is. For instance, a disease breaks out somewhere but there is no foretelling when it is going to occur, nor can we be forewarned about it. If however it is a new disease and unforeseen expense is likely to be incurred, naturally one has to discuss the matter with the Director and see if operations can be carried on. But in the nature of my work, a good deal must be left to the Head of the Section, for one is very interested in some diseases and not quite so interested in others, and there is no particular reason why that should not be so.

A.2058. You do not think that there is a danger that the Head of a Section may tackle a particular problem because it interests him and lay aside problems which although they may not interest him, are of more pressing economic importance at that moment?—I do not think he would be allowed to do that. When the Director came to know about it through our monthly, annual or tour reports he would immediately bring pressure to bear on the Head of the Section.

A.2059. How about the touch between Pusa and the Provinces?—Until the last six years we used to have sectional meetings. We had three such meetings in Pusa, held once in two years. Then came the great financial stringency when it was difficult to get Mycologists from the Provinces to come to Pusa and the meetings were held in abeyance. A meeting was due again this year but had to be postponed owing to the Agricultural

Commission. At any rate there is no inherent reason against holding these meetings. The members were debarred from coming because of the difficulty of getting the money for their travelling allowances. With only one officer in the section I do not get about the Provinces as much as I should like to. Whenever I can get an opportunity I tour in the Provinces, I meet the Mycologists. Discussions with them about the work afford much mutual benefit. I get help from them and they get help from me.

A.2060. On occasions when you show signs of proposing to go to the Provinces, are you ever frightened by the bogey of these Devolution Rules?—If one is careful in writing down reasons for a tour one can get round the objections. The diseases that I am working with in Pusa are found in most Provinces in India so that I can go on tour to extend my knowledge of them. Madras, however, is the only Province whose diseases I am not actually working with but I can get to it also because I am responsible for the diseases of the Cane Breeding Station. Generally one has got to be very careful in planning one's tours. One does not go quite as often as one would like because of the rules, but I have never proposed a tour which has been stopped because of audit objection.

A.2061. Do you get sufficiently early information from remote districts of the incidence of any new disease?—It is very difficult to answer a question like that. Diseases have been there for so many years. The only way to get information is when a person living in a remote district comes in contact with an officer of Government or some one in touch with such an officer. I will give you one instance of my experience in Madras. A ryot from the south of the Presidency came with a box of specimens of grape-vines that were covered with the loveliest specimen of mildew; we knew the disease which is common in France; we told him that we could not do anything that year; but that when he pruned his vines the next year, we would come and spray them; we did that and we were successful. The reason for his appeal to us was as follows. The Industrial Department was trying to persuade people to use oil engines to pump water out of their wells and an overseer who was fitting up a pump had a copy of the agricultural calendar published in Madras. In this calendar was a note in vernacular about the smut of *juar*. The man wondered if this plant-doctor who wrote the article had not a medicine for the vine disease. He put the specimens in his box and came to Coimbatore. At the pruning time we sprayed three gardens, one once, one twice and the other three times. He found that two sprayings were sufficient. Next year every one wanted to purchase the sprayers and gradually as sprayers became available they were bought. All that we promised to do was to send a man there each year to put all the sprayers in order at the beginning of the spraying season.

A.2062. That was a good illustration of the utility of propaganda in the vernacular, was it not?—Yes.

A.2063. Is not that a good point on behalf of the literacy of the cultivator?—Yes.

A.2064. Are you satisfied with the present arrangements for protecting India against the importation of plant diseases?—I am satisfied with them.

A.2065. Are there any occasions, in connection with your own field of working, in which it would be of any advantage if it were possible to control movements of vegetable substances from one Province to another?—I do not think there is very much field for that except in special diseases in special localities. The wind blows spores about so much that I do not think very much can be done in that way.

A.2066. Have you anything that you would like to tell the Commission about post-graduate training in Pusa? You have probably heard the evidence given by the previous witness?—Yes and I do not think I have very much to add. In my subject, students come with probably the minimum amount of knowledge for any post-graduate course in the Institute. I have had four post-graduate students so far. Two of them were B. Ag.'s, one was a B.A. of Calcutta and the other was a B.Sc. of Aberystwyth, Wales.

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A.2067. Did you hear Dr. Shaw's evidence in full?—Yes.

A.2068. Did you hear his views about the inadvisability of linking up this institution with the Universities for the purpose of conferring a degree?—Yes. So far as the post-graduate students are concerned, I think there is no need for it. Each student has had a science degree from a University or from a college affiliated to a University. If he produces a thesis on the work done in Pusa, he can get a D.Sc., Ph.D., or M.Sc. from his own University.

A.2069. Without any special arrangement?—I do not know about the details.

A.2070. If special arrangements were required for that, would you advocate such special arrangements being made?—Yes.

A.2071. Are you familiar with the constitutional position under the Reforms?—I have only the ordinary man-in-the-street's knowledge.

A.2072. Do you think it is conceivable that the advice of Pusa could be forced upon the Provinces in any way?—Only in one way.

A.2073. In what way?—If the advice is backed up with money grants. There is no other way.

A.2074. *Sir Ganga Ram:* Do your experiments arise out of your own initiative or do the Provinces refer their problems to you?—Both. Once a year I write to every Director in the Provinces and ask him if there are any problems that he would like taken up in Pusa. Sometimes he says he has none; sometimes he says he has. Sometimes I take up the work and at other times I cannot.

A.2075. Before undertaking any experiment, do you keep yourself well informed whether the same experiment has not been conducted in any other Provinces?—Yes. We get the annual report from every Province and in this some mention is made of all the work that is being done, besides I am in direct correspondence with the Mycologists.

A.2076. *Sir Thomas Middleton:* Have you made a general review of the incidence of plant pests throughout the country?—We have not gone very far in that direction. For a long time the only Mycologists were in Pusa and Coimbatore and it is only within the last 5 years that we have got men stationed at Poona, Nagpur, Cawnpore and Mandalay. Each man now is making a list of diseases of crops for his Province and that is one of the subjects that I hope to bring up at the next Conference. In Pusa we have got a card catalogue of all the fungi known to cause disease in India, in which is recorded the locality from which the fungus comes and the Director of the Imperial Bureau of Mycology has in hand the publication of a list.

A.2077. So there is need for some such review and you are thinking of bringing the subject up before the next Conference?—Yes.

A.2078. In connection with the recruitment of officers to the provincial departments, you suggest that the best plan would be for the Director to recruit a graduate and send him to Pusa for some post-graduate instruction. Then, after he has been sometime in the service of the department, he might visit some foreign University for further study?—Yes.

A.2079. As an alternative to that, do you not think it might be a better plan if the Director offered a few scholarships to the most promising graduates in his Province and sent these scholars to Pusa for a post-graduate course and made his selection after they had been through the post-graduate course at Pusa. You have pointed out that the amount of knowledge of mycology which students have on coming to Pusa is practically nil and it must be difficult for the Director to make a selection before serious study has begun?—More depends on the kind of man than on the amount of knowledge at that stage. All the students that have come to me have come with a view to using mycology as a means of earning a livelihood. During the last 20 years there has been, taking posts of every kind that might be called somewhat higher, only half a mycologist's post vacant per year. In some Provinces there have been no appointments. If a man came from Bengal, there is no Mycologist there and he has little chance of getting into Madras or the Punjab. So, what I fear is that the Director would give scholarships to half a dozen men and he would only choose one. I think it would be better for him to wait until he found the right kind of man before he tried to post him. At this stage I admit that he cannot say whether a man is going to be a good research worker and that after he has been through the course at Pusa, the Director is in a better position to estimate his worth. Later on, if he is going to be a really good man, he needs the experience of another University; that is my general idea.

A.2080. Your idea is largely based upon the fact that the number of appointments is so very small?—Yes.

A.2081. Do you not think there is room for a considerable increase in the number of Mycologists in the provincial departments?—Talking practical politics, I doubt if there will be any great extension at the present moment.

A.2082. Is there room for more Mycologists, having regard to the depredations of fungi alone?—The field is inexhaustible. I think there ought to be one more mycological laboratory in North-East India. For instance, in the Assam-Bengal group disease work can be done from Pusa to a certain extent but not adequately. I think that a man stationed in an area is necessary to gain the detailed knowledge which only residence in the locality can give him. I think extension of staff should take place in this way and that a nucleus of three mycologists should be maintained in Pusa. Just now we have got only one.

A.2083. *Sir James MacKenna:* Have you any relations with the mycological work done at Tocklai in the tea estates?—I have no direct relation; I have only seen Dr. Tunstall's work.

A.2084. Is it a fact that Dr. Tunstall has been brought out to investigate one particular mycological disease?—Yes, but he did so well that he has gone on to investigate other diseases.

A.2085. There is not much inter-relation between Dr. Tunstall and yourself, except that he consults your library?—Dr. Tunstall does all the work on tea. He comes to Pusa chiefly to consult the library and the herbarium with regard to the naming of his fungi, because we have got a very good library and herbarium.

A.2086. What are your relations with the Bureau of Mycology in London?—So far, we have sent all the specimens of fungi to it, because Dr. Butler has got far better facilities for getting them named; we leave all the naming to him, and he primarily deals with that. Sometimes, he cannot do it in London, but he gets the best men on the Continent or in America to do it for him. Last week we had a case where he got a fungus named at Trieste.

A.2087. The Bureau of Mycology is of very great value?—It is of very great importance.

A.2088. And you think that the Government of India contribution should be continued?—I think so. When I went Home last year, I met Dr. Butler, who had come back from visiting mycological institutes on the continent. He knows exactly what is going on there, and I had a long talk with him. We can get information from him about men whom we cannot actually see, but whom he has seen and who are interested in the work. Then, his *Review on Mycology* is a most useful publication because he gives quite a long summary of each article reviewed.

A.2089. Is it not a fact that a mycologist is a botanist extraordinary? —Yes.

A.2090. The slow development of mycology in India is not due to the fact that there are not enough trained Botanists?—I do not think it is very slow as compared with European countries; it is slow as compared with America.

A.2091. There are as many in India as there are in England?—Probably more.

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A.2092. Therefore, there is no great point in multiplying the number of post-graduates, unless from the technical side?—A post-graduate student usually looks for employment.

A.2093. So long as you can find a job for him, you may train him up?—Yes.

A.2094. A mycologist is a super-botanist; he must be a first class botanist before he can be a mycologist?—Yes.

A.2095. *Professor Gangulee:* At the same time, you agree that it is necessary for any worker in India, for instance, a plant breeder, to know something about mycology?—Yes.

A.2096. What is your relation with the Pathological Institute in Holland?—I have no direct relationship with it; we send them specimens of fungi occasionally.

A.2097. Have you paid a visit to that Institute?—No.

A.2098. Do you get invitations from International Congresses and Conferences convened by those people?—Yes.

A.2099. Do you send any papers to them?—I have never sent any paper to them.

A.2100. Are you continuing the work carried on here by Dr. Butler?—Yes, I am carrying it on. We are collecting fungi and giving descriptions of the fresh specimens and the measurements of the fresh spores before we send them to him. In that sense we continue the work.

A.2101. You are aware that Dr. Butler's work is the foundation of Indian mycology?—Yes.

A.2102. With regard to your own work here, you say that mosaic disease is widespread in India, but its extent is not yet known definitely. Are you not able to get the information that you want to have through the co-operation of the Provinces?—Yes.

A.2103. Most of the Provinces except Bengal have a Mycologist?—Yes.

A.2104. Through the co-operation of the provincial Mycologists, can you not get the information that you want to have as to what is the extent of the disease, what loss it causes, how it is spread and to what extent?—They are finding out these things now. I have come back from a tour in Madras, and I know that the Mycologist there knows how far round his stations the disease exists; that has also been done in the Central Provinces.

A.2105. With regard to mosaic disease, I was very much interested in what you showed us this morning. Are you carrying on any experiments on any fundamental questions like the problem of the susceptibility or resistance of canes to this disease?—Yes, we have been doing it since last year.

A.2106. Is there any variety of sugarcane which is immune to attack from mosaic disease?—One of the main objects of my work on this disease is to find this out. There are several varieties of canes, that are not attacked but whether they are immune or not we do not know because we have not had time yet to test them.

A.2107. Is the *Uba* variety susceptible?—Mosaic has been observed on *Uba* at Gurdaspur in the Punjab. Another similar disease, streak disease, has been observed on *Uba* at Aligarh in the United Provinces and Gurdaspur.

A.2108. You breed, as I understand, standard canes free from mosaic disease?—Yes.

A.2109. Are you in touch with the plant-breeding section when you carry on this work of finding out the mosaic resistant varieties? Are you in touch with the breeding department in Coimbatore?—Yes; I am responsible for keeping the Cane Breeding Station free from disease. I was there twice last year.

A.2110. You have already made a reference to the Destructive Insects and Pests Act. Can you tell the Commission whether you are satisfied with the operation of that Act?—It is very difficult to judge whether it has been carried on well or not. It is carried out by preventive officers, who are skilled in preventing things from coming into the country. If a living plant arrives without a certificate these officers do not let it in but send it back or destroy it. We cannot get the work done much better than that.

A.2111. That of course is meant to protect us against foreign infection. What about internal infection? Do you think it is possible to have any legislative measures against the dissemination of these parasites within India?—I have mentioned that in my note. There is not very great scope for it. It is in special cases only that we can hope to control the spread of a disease.

A.2112. With reference to specific diseases it is possible, but not generally applicable?—Yes.

A.2113. *Mr. Calvert:* Is any work possible in the direction of introducing diseases for the destruction of weeds which we do not want, such as water-hyacinth?—We tried probably about 50 fungi on water-hyacinth, but it did not become infected by even one.

A.2114. It is disease-resistant; is that the case with similar weeds like lantana?—I do not say there is no hope, but the work on that particular problem has not been done in India to any great extent.

(The witness withdrew.)

The Commission then adjourned till 10-20 a.m. on Wednesday, the 12th January, 1927.

Wednesday, January 12, 1927.

PUSA.

PRESENT:

The MARQUESS OF LINLITHGOW, D. L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.
Rai Bahadur SIR GANGA RAM, KT., C.I.E., M.V.O.
Sir JAMES MACKENNA, KT., C.I.E., I.C.S.
Mr. H. CALVERT, C.I.E., I.C.S.
Raja Sri KRISHNA CHANDRA GAJAPATI NARAYANA DEO of Parlakimedi.
Professor N. GANGULEE.
Dr. L. K. HYDER.
Mr. B. S. KAMAT.

MR. J. A. MADAN, I.C.S.
MR. F. W. H. SMITH. } (*Joint Secretaries.*)

Mr. T. BAINBRIGGE FLETCHER, R.N., F.E.S., F.L.S., F.Z.S., Imperial Entomologist, Pusa.

Replies to the Questionnaire.

QUESTION 1.—(*a*) (*i*) and (*ii*) So far as entomology is concerned I consider that this science should not be studied as a separate entity concerning only agriculture or veterinary research. Besides these departments, entomology is intimately connected with forestry, medical science, zoology and commerce (under which heading may be included all Government departments and the general public interested in the protection of all kinds of stores from the depredations of insects). Therefore I consider that all research work in entomology should be carried out by a properly organised entomological service. Proposals to this effect were put forward by me ten years ago (*vide* Appendix K to Report of the Indian Industrial Commission) and subsequently, in reply to criticism that my original proposals were on too modest a scale, I submitted in July 1920 a revised note* of which a copy is attached hereto. This scheme, after acceptance of its principle by the Governments and departments concerned, was shelved in 1922 on the ground of financial stringency. I have already shown elsewhere (*Proc. Fourth Entl. Meeting*, pp. 10-11; 1921) that the annual losses caused by insects in India reach the enormous figure of two hundred crores of rupees, this figure disproving any idea that entomology is a minor science of little practical importance to the welfare of the Indian Empire. As I said then, "If we, by a study of insects and by practical application of the knowledge gained thereby, can save even one per cent of this enormous wastage of the national wealth of India, such a saving would more than justify the most complete expansion of entomological work that we can possibly imagine."

In reply to this question, therefore, I submit that the Commission will inquire into my scheme for a properly organised service for the prosecution of research work in entomology and will lend it their powerful support if it appeals to them.

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* Not printed.

As regards general obstacles to progress in research under present conditions, I would draw the attention of the Commission to the following points:—

(1) The time of most so-called research workers is so occupied with routine and other work as to leave very little time for fundamental research. This is partly due to the large increase of work during the last twenty years without any concomitant increase of superior staff (in the case of the Entomological Section at Pusa this staff has been reduced) and partly to the large amount of clerical work which has to be got through.

(2) The regulations, which have been brought in of recent years, regarding touring, which practically prevent the Pusa staff visiting the Provinces, as was done formerly, and also the Provincial staffs from visiting Pusa as often as is desirable, thus accentuating want of co-ordination on account of want of knowledge of what is being done in other localities.

(3) Dissatisfaction of the present staff with rates of pay and allowances and a general feeling that there is no appreciation on the part of Government of good work.

(4) The regulations regarding budget allotments militate against economic use of the money provided. There are special difficulties regarding the obtaining of rare books which are essential for research work.

(5) The climatic conditions at Pusa prevent an output of work which could be attained under better conditions, besides presenting unnecessary difficulties in the upkeep of collections, books, records, etc.

(*b*) The main need at present is for more skilled workers and for greater co-operation between workers. So far as concerns the research necessary as the foundation of all successful economic work, both these requirements can be best met, in my opinion, by the centralisation of research workers, together with their apparatus, leaving to the provincial staffs the application of economic work, founded on such research work.

As regards problems on which sufficient progress is not being made, please see the list already given in my note, of July 1920, regarding proposals for expansion of entomological work.

Of the agricultural problems therein included, the subject of borers in sugarcane has already been worked out at Pusa so far as concerns the local fauna of the surrounding district, but we can have still to accumulate very considerable information regarding all the cane-growing districts of India. The subject of boll-worms is also being investigated by the Government Entomologist in the United Provinces, but, here again, what is required is much more information from all over India. Tea pests in North-East India are dealt with by the Entomologist to the Indian Tea Association, but this officer is a non-official and we know very little of what is being done, whilst the tea districts of North and South India are outside of his scope.

The forest pests which require special investigation at present are pests of (1) *sal*, (2) conifers, (3) teak, (4) South Indian forests and (5) stored timber and fuel.

Some medical problems in which entomological work is required are (1) mosquitoes, (2) Muscid flies, (3) fleas, (4) *Kala-azar* investigations.

Veterinary work is directly concerned with insects as pests of animals and carriers of animal diseases. The groups of *Tabanidæ*, *Oestridæ*, *Muscidæ*, *Hippoboscidæ*, fleas, and lice and the problems of transmission of diseases such as surra and rinderpest are of especial importance.

On the commercial side, there are important problems connected with insect damage to army stores, railway sleepers, tobacco factories, etc.

Besides the economic aspect of the above groups of insects, it is necessary to provide for progress in the study of their bionomics and systematics, without which economic work must fail to be really permanently useful. "Catch and kill" methods, when damage is already being done or has been done, may impress the general public from a spectacular point of view, but are of very little permanent value, even as demonstrations; what is required are permanent control methods, founded on a knowledge of insect bionomics, which may be applied as a regular routine to prevent damage being done.

(c) I cannot suggest any particular subject for research which is not being or has not been investigated to some extent. Such methods of control as the dusting of crops by means of aeroplanes are still in the experimental stage in America and further data must be awaited before we are in a position to try such methods in India.

Question 2.—(i) There is not at present in India any institution or teaching staff *ad hoc* at which or by which a really satisfactory course in entomology can be given. If this question refers to purely agricultural education, I consider that the instruction in elementary entomology given to students in the agricultural colleges was fairly satisfactory on the whole, but the present regulations for touring have prevented my conducting the usual examinations of these students for some years now.

(*vii*) As regards the agricultural students in the provincial colleges, I do not suggest any modifications other than that included in my scheme for an Entomological Service, *viz.*, to send a Lecturer from the central Entomological Institute to give a short course of lectures annually to the students at each provincial agricultural colleges and, if necessary, to inspect the entomological courses at the colleges and to keep them up to the mark. Such a type of lecture-course would ensure efficiency, by using the services of a specially picked man equipped with the latest facts, and economy in the preparation of specimens, models, diagrams, lantern-slides and films, etc., this course of lectures being, of course, supplementary to the regular course of instruction.

As regards the present course of training at Pusa it is quite evident that it is impossible (apart from any question of teaching staff) to train to Imperial Service standard, in the short period of two years, a student who starts with only an extremely elementary knowledge of entomology. The Conference to consider post-graduate training at Pusa, which was held during the Board of Agriculture Meeting in 1921 and at which I was present, considered only training in agriculture (*i.e.*, farming) and no mention was made at that Conference of any regular course in entomology. Had this been done, I should have pointed out at that time the inadequacy of a two-years' course. If training to Imperial Service standard is required, a proper course must be worked out and a proper teaching staff be provided. Students eligible for admission to post-graduate courses under the present rules may not only lack practically all knowledge of entomology but they also lack any knowledge of the languages (French, German and Latin) which are essential for acquiring a knowledge of published work in any branch of research which they may wish to take up. I should hesitate to give any definite period as a minimum for the necessary training of the present type of student; but if he has to be taught languages, which are essential, as well as all the other subjects (such as insect morphology, physiology, development, taxonomy, etc.) which necessarily precede a course in applied entomology—and instruction in both pure and applied entomology must necessarily precede any attempt at research work—I should certainly estimate at least four or five years for a satisfactory course of training. It must be remembered, also, that our knowledge of Indian insects is itself in a comparatively elementary stage. For example, there are no text-books on the morphology, histology, embryology, or physiology of Indian insects, and the materials for such studies are at present scanty.

Another point to which I would draw attention in this connection is that entomology must be considered as a whole and that entomology as applied to agriculture cannot be divorced from entomology in its relations to forestry, medical and veterinary work and general zoology. Any proper course of training in entomology, therefore, should be so arranged as to give one general course in this subject for the first two or three years, the students thereafter specialising in the subject as applied in any special direction (agriculture, forestry, etc.).

In any case, it is impossible to obtain satisfactory experts merely by passing students through courses of training regardless of whether they have any real innate aptitude for a subject such as entomology. In biological work it is the man that counts, far more than any training, and unfortunately the supply of really keen entomological workers is practically non-existent in India.

At present also there are practically no openings for Entomologists except in Government service. Therefore, unless men are sent to be trained for posts to which they are intended to be appointed, students have little hope of obtaining posts at the conclusion of their course.

It would seem preferable at present to limit training mainly to students who had been definitely selected for appointments. After training and after a further period of practical work, I should like to see them sent abroad for at least a year to work with a specialist in their particular subject and to broaden their minds.

(viii) Any course of nature study in schools should include a simply written account of a few common Indian insects, showing their life-history, development and connection with man as crop-pests and carriers of disease to men and animals. The chapter on "Insect Life and Insect Pests," which I wrote for Clouston's "Lessons on Indian Agriculture," may perhaps be cited as the sort of thing which I advocate.

It is useless to attempt to teach information regarding insects, birds, etc., unless such information deals with common animals which can be actually shown to the students. Many courses of nature study in India have been framed, I believe, on non-Indian text-books which do not fulfil this requirement.

QUESTION 3.—Please read my note on "Publicity for Entomology in India" (*Report of the Fifth Entomological Meeting, held at Pusa, 1923,* pp. 388-390) and also a paper on "Stored Grain Pests" (*Report of the Third Entomological Meeting held at Pusa, 1919,* Vol. II, pp. 712-761).

QUESTION 4.—I have already suggested means for the better co-ordination of entomological research work in India. (Please see reply under Question 1). The main idea underlying my suggestions is that the acquisition of knowledge regarding Indian insects should be made by a centralised staff of research workers, based on one central Entomological Institute, whilst the application of such knowledge would be made by the provincial or departmental authorities concerned.

Under present conditions, everything possible in the direction of co-ordination is already being done by Pusa as regards the Entomological staff of the Provincial Agricultural Departments, of the Forest Service, of the Zoological Survey, of the Medical and Veterinary Departments and of other entomological workers in and outside of India by—

(1) personal relations, including loan and exchange of specimens, literature and information generally,

(2) the publication annually of an abstract of all current literature on Indian insects.

(3) the Entomological Meetings to which all interested are invited.

Please see my Note on "Co-operation in Indian Entomology" (*Report of the Fifth Entomological Meeting held at Pusa, 1923,* pp. 382-387).

QUESTION 7 (*a*).—Whilst not suggesting means for reducing loss due to fragmentation of holdings, I should like to point out that control of insect pests is rendered much more difficult when holdings are sub-divided.

QUESTION 13.—(*i*) The existing measures for the protection of crops from external infection by insect pests are all that can be applied under present conditions of staff, provided that these measures are properly applied.

Mr. T. Bainbrigge Fletcher.

There is, however, undoubtedly some leakage of undeclared plant imports into India by passengers who bring in plants in ignorance of the fact that they are thereby contravening the law. The Customs Form which has to be filled in by all passengers prior to arrival at an Indian port does not mention plants at all; this should be amended to ensure that all passengers declare whether they are bringing in any living plants.

I have already drawn attention of Government to the difficulties which will arise when a regular Air Service to India is started.

(*ii*) I understand this question to refer to the desirability of limiting the spread of insect pests from one district to another within the Indian Empire. Under present conditions, this is outside the range of practical politics.

With a properly enlarged and organised entomological staff, we should be in a better position to commence work on these lines, the first requirement being the collection of information regarding the exact distribution of insects in India. This is, of course, part of our present survey of the insect fauna of India. Detailed inspection of botanical gardens, nurseries, orchards, etc., would doubtless yield considerable interesting facts, at present quite unknown to us, regarding the presence and distribution of insect pests which are so easily sent out to new localities by stock sent from or to such places.

At least one botanical garden in India regularly fumigates all plants sent out, before despatching them, but most of such places are undoubtedly *foci* for distribution of pests, as is soon evident to anyone who will take the trouble to examine living plants despatched by rail from one place to another in India; on examination such plants are almost always found to be infected with one or more scale-insects, *aleyrodids*, etc.

In connection with this subject I would again point out the necessity of dealing with it from the point of view of India as a whole. The entomological staff of a Province may have a good knowledge of the insect pests of that Province but is in a very poor position to know what pests occur outside the provincial boundaries—and it is the pests, that do not occur already in an area, that require to be kept out.

QUESTION 15 (*g*).—I consider it very desirable that a proper staff should be provided for the prosecution of studies on insect pests of domesticated animals in India. At present comparatively very little has been done in this line and extensive work is required in (*i*) collecting material and information relative to the occurrence of such pests, (*ii*) investigating their (*a*) life-histories, (*b*) systematics and (*c*) control, and (*iii*) ascertaining their connection with animal diseases. This last particularly must of course be done in close collaboration with veterinary workers. I have estimated the annual losses to livestock in India due to insect pests as being upwards of four crores of rupees, so that this branch of entomology is by no means unimportant. I have already projected a book on Veterinary Entomology in India and gathered a good deal of material together with this end in view, but it will still take sometime to complete.

We require, not only general investigations, which will undoubtedly reveal many new pests of which we are completely ignorant at present, but also special research, in direct collaboration with veterinary officers, into the rôle of insects as vectors of diseases such as surra and rinderpest.

Some of the lines of work in veterinary entomology deal with the same groups of insects as are included in medical entomology. It is therefore the more desirable that the insects responsible for carrying human and animal diseases should be dealt with by the entomological staff of a single Entomological Service, to prevent overlapping.

QUESTION 17 (*c*).—Bee-keeping. The main reason why the demand for honey in India is met at present by supplies to a very inadequate extent is because the methods of extraction and preservation of honey are so defective that good honey can only be obtained in particular districts at certain seasons of the year, when it is freshly collected, and at other times only a thin stale fermented article can be procured. It is a significant fact that, if one inquires for honey in any of the larger towns of India, one is generally offered good honey only of the bottled or tinned variety imported from America or Australia. Yet it is certain that the quantity of honey produced every year in India is very large, how large it is quite impossible to say with any exactitude but it probably runs to several scores, if not hundreds, of millions of pounds, as wild honey-bees of one or more species occur in practically all non-desert areas. Besides honey, bees also produce wax, which is collected in large quantities for sale (and, incidentally, is invariably found adulterated when bought in the market), and they also do incalculable benefit by their active share in the pollination of flowers. It is hardly necessary to point out that there is a great demand amongst the peoples of India for honey, which is used both for religious ceremonies and as a valuable food. There seems to be no reason whatever why India should not produce its own supplies of honey to meet all internal requirements and even have a surplus for export, instead of being an importer. This end can be attained by effecting improvements in the methods of keeping the present races of native bees and of extracting and preserving their honey, as well as by judicious crossing of the Indian with exotic bees. To carry out this aim it is necessary to have a whole-time expert in bee-keeping to (1) make a survey of the present methods of bee-keeping in India, (2) select and experiment with the most promising races of Indian bees, (4) supply improved strains of bees to bee-keepers throughout India, (5) show by practical demonstration improved methods of hiving and handling bees and the preparation and preservation of honey and bees-wax, and (6) train selected Indians in such improved practices, We have done some work on these lines at Pusa in the past and have proved that it is possible to increase the yield of honey and to preserve it quite satisfactorily, but with the present staff it is impossible to take our results any further. Pusa also is climatically an unsuitable locality for such experimental work on any large scale.

Fruit growing.—Owing to the permanent nature of such crops, fruit trees are especially liable to the attack of numerous insect pests. Fruit growing is therefore pre-eminently an industry in which entomological assistance is strongly called for if it is to be productive. The subject of fruit flies in India is also an important one.

Sericulture.—This subject was dealt with at great length in the "Report on an inquiry into the Silk Industry in India," by H. Maxwell Lefroy and E. C. Ansorge (Calcutta; Government Press; 1917; 3 volumes), and their main recommendations are summarised at pp. 209-211 of Volume I. With these recommendations I am in general agreement but I would wish to point out that the main requirements of sericulture in India are commercial and not entomological.

Pisciculture.—The importance of insects to fisheries in India was dealt with by Dr. Baini Prashad in a paper which appeared in the Report of the Third Entomological Meeting, Vol. III, pp. 906-909 (1920). No really detailed work has been done on this subject in India but there is no doubt that insects, both as food for fish and as destroyers of young fish, do play an important part which would be well worthy of investigation.

Lac culture.—This is fully dealt with in Pusa Bulletin No. 142 on "The cultivation of Lac in the Plains of India," of which three large editions have been exhausted and a fourth is now in preparation. This subject has now been taken up by the Lac Association, which has a laboratory situated at Ranchi. The main obstacles in the expansion of lac culture seem to be:—

(1) Fluctuations in market prices. When prices are low, practically no lac is collected, with the result that natural enemies of the lac insects flourish unchecked and the subsequent production of lac is poor in quantity and quality. When prices rise, little lac is obtainable at first and, when efforts are made to cultivate it, which takes time, there is often over-production so that prices fall again to a low level at which it does not pay to produce it.

(2) The above condition is related to the frequently unfair prices which are paid by the middlemen-buyers to the actual cultivators. Even when prices are high, the actual growers benefit very little and thus have no inducement to production.

(3) Adulteration of the stick-lac and shellac, which reduces sales in the export market.

(4) The prevalent practice of collecting the stick-lac before the emergence of the young insects. This practice was adopted of old because the lac was originally valued for its use as a colouring-matter (dye), and for this purpose it was collected before emergence of the young insects, in the same way as cochineal used to be prepared. With the introduction of aniline dyes, the use of lac as a dye has practically gone out, but the old method of collection is still carried on, thereby destroying the major part of the young insects which would otherwise survive to found new colonies. Under modern conditions there is no reason whatever why the stick-lac should not be collected after the young insects have swarmed out, which they do at fairly definite dates.

(5) Difficulties in obtaining brood-lac when required in any quantity and in many areas, want of the trees on which to propagate it. In this connection, the planting of trees, such as *ber* or *kusumb*, suitable for lac-growing, might be considered in connection with any scheme for tree-planting to prevent erosion.

QUESTION 25 (*a*).—Please see my reply to Question 1 (*a*).

So many diseases (*e.g.*, malaria, plague, typhus, *kala-azar*) are carried by insects, that it is very desirable to strengthen the entomological side of any organisation for the investigation or control of such diseases.

Oral Evidence.

A.2115. *The Chairman:* Mr. Fletcher, we have your note of evidence for which we are obliged; do you wish to add any statement of a general character at this stage?—Yes, I should like to say that my evidence is given purely as regards the Entomological Section, the entomological aspect of our work here. As was noted yesterday, the different sections here are practically different research institutes each on their own subject. It is, I think, inevitable that the different sciences connected with agriculture have developed in some cases more than in others, with the result that some of the answers given by Heads of sections are not applicable to all the sections here. I do not say this with any idea of leading the Commission to think that there are differences of opinion between the different sections: I merely wish to point out that questions have been asked to which the replies would have been different had these questions been addressed to other sections.

A.2116. I hope I shall succeed in touching on one or two of the questions of which you are thinking. Will you give the Commission the outstanding points of your own training and any past appointments that you have held?—I was educated at Dulwich College from 1891 to 1895; I was on the science side there. In January 1896 I went into the Royal Navy as an Accountant Officer. From 1896 to 1900 I was out on the China Station. After that I did 3½ years in the Mediterranean; then I was employed in the Indian Ocean for about 6 months, and for 4 years in Ceylon. After that I came to India in 1910 as Supernumerary Entomologist. In January 1911 Mr. Lefroy, who was Imperial Entomologist, went on leave and I officiated for him until April 1912, when I went down to Madras to occupy the newly created post of Government Entomologist. There I organised a new entomological section at Coimbatore; I remained there until December 1913 when I returned to Pusa as Imperial Entomologist, a post which I have held since that date.

A.2117. Is there anything you wish to say as to the suitability or otherwise of the site of Pusa?—I can say that Pusa is a most unsuitable locality from the entomological point of view.

A.2118. Why?—Because the climate is quite unsuitable for the preservation of specimens and also for the rearing of specimens during about half the year. In addition to that, it is not a pleasant climate to live in and therefore you do not get the full amount of work from the staff that you would get under more pleasant conditions.

A.2119. What would you regard as the ideal site for your section?—I have already suggested Coimbatore as a much more suitable locality than Pusa. I do not say it is wholly ideal, but it is the best that I know of.

A.2120. How about the co-ordination of the various sections at Pusa?—It is quite satisfactory so far as I am concerned.

A.2121. Is it an advantage for the purpose of co-ordination and intercommunication that the various sections should be situated together in one place?—I do not think it is essential, because if we had an entomological station in Coimbatore, there is an agricultural centre there, and if any agricultural problem were required to be discussed, there are agricultural officers with whom to discuss it there; incidentally, there is also the Forestry Institute there, so that forest problems could be discussed.

A.2122. How about the touch between you as Imperial Entomologist and the Provinces?—That is very largely, I think, a personal matter; so far I have had no difficulty; I ask them for information and they give it freely; they ask me for information and we give it. If they want to work on a particular group of insects we send them all our material, and if we want material they send it to us. Every month we have to send in here a monthly report of the work done in the section; I send copies of my monthly report to the Government Entomologists in Madras, the United Provinces and the Punjab, and they send me their monthly reports from Madras and the Punjab; so that I keep, as far as I can, in touch with the work which is being done and try to keep them in touch with the work that is being done. In addition to that, of course there is a good deal of personal correspondence.

A.2123. *Sir Henry Lawrence:* You mentioned three Provinces?—There is no Government Entomologist in Bombay; I only send a copy of my monthly report to Provinces which have a Government Entomologist, not to the Provinces which have only an Assistant. I brought that point up at the last Entomological Meeting, and it is referred to in my remarks in the paper on co-operation; there I suggested tentatively that perhaps we might get in reports from all the Provinces here, reproduce them and circulate them, so as to let everybody know what is going on as far as possible.

A.2124. Would you give the Commission an account of the functions of your office under the present arrangement?—The functions of my office are to deal with all aspects of Indian entomology. The only exception that we make is that we do not deal definitely with forest pests because these are dealt with at Dehra Dun; otherwise we try to take in every aspect of work on Indian insects.

A.2125. Assuming efficient sections under the Provincial Governments, in the various Provinces, would there be any field left for you?—Yes, the field is absolutely unlimited for every Province and for every worker in India at present; we have only touched the fringe of the field. The objection to that would be that, if every Province had its own efficient staff, you would have so many large staffs, which would have to be large to do the work efficiently, that necessarily you would have a tremendous duplication of work being done, institutes, laboratories, libraries, collections, records. It would be a vast expense to the country as a whole and you would necessarily tend to get less co-ordination.

A.2126. Do you travel about the country?—Yes, on the whole I can say I do; I have visited, I think, every Province in India; but of late years I have not travelled as much as I used to.

A.2127. Why?—Partly because the work here is constantly increasing and I cannot get away so much; partly because facilities for touring are not what they used to be.

A.2128. In what way?—Partly in that our travelling allowance has been cut down. In the old days, when I came out here, we used to get double first class when we travelled, and, taking one thing with another, that just about covered expenses. Now, since 1923 I think it was, our rates have been cut down to one and three-fifths and, practically speaking, that does not cover the cost. Another reason is the Devolution Rules.

A.2129. What Devolution Rules do you refer to?—I will just give an example; this is a note which was sent in by Mr. Husain who was officiating for me during my absence on leave last year; he wanted to send out a man from here to obtain information with regard to pests; he sent up a request to the Director here, and this is the reply which he received: "The officiating Imperial Entomologist appears to ignore the administrative problem involved. Under the Government of India and the Devolution Rules central funds are not to be expended on what are really provincial concerns. This point is carefully scrutinised by the Finance Department, and it is the duty of the Agricultural Adviser as controlling officer to assure himself that this condition is fulfilled before he affords sanction for proposed tours and lines of work."

A.2130. Who signed that note?—Dr. Harrison when officiating as Agricultural Adviser. If somebody writes to us to say there is a pest which is attacking his crops, in my opinion the first thing we should be able to do is to send a man straightway to see what is going on, either to be able to advise them on the spot, or, if the man finds he cannot advise them, that he is not competent to advise them, to bring back specimens here and tell us all about it.

A.2131. In the case that you have mentioned, what exactly was the work for which the journey would have been made?—That does not appear on this record and I was not here at the time, but I understand it was one of these cases of a pest appearing and a letter coming in to us asking for advice.

A.2132. It was an emergency?—Yes.

A.2133. *Professor Gangulee:* From what Province?—I think from Bihar.

A.2134. *Sir Henry Lawrence:* In your opinion is it the proper work of the central department to investigate that?—I certainly think it is; I think one of the functions of the central department is to keep as complete a record as possible of outbreaks of pests.

A.2135. You as Head of a branch have no discretion in the matter under this ruling?—No. If I have got to write up and get permission to send a man out, by the time I have done that probably everything is over.

A.2136. *The Chairman:* Are you in touch with research workers in other countries?—Yes, I think we may say we are more in touch with workers in other countries than any other section of this Institute; I have constant requests for information and help from other countries. Quite recently I had a request from Japan for information regarding parasites of a borer in maize. I might mention we have in India, at the present moment, a man from the American Bureau of Entomology collecting material for his own country.

A.2137. Are you satisfied with the existing arrangements to protect India from invasion by harmful insects from overseas?—I have replied to that question in my written evidence.

A.2138. So that you have nothing to add to that?—No. I think the conditions are as good as we can get them under existing circumstances. With a properly organised and large enough staff we should take it over eventually and have a proper entomological section. With the present staff we could not do it.

A.2139. Have you anything to say upon the question of limiting the spread of harmful insects by some control as between Province and Province?—I have nothing to add to what I have already stated.

A.2140. *The Raja of Parlakimedi:* Are any Indians being trained here as Assistants to yourself?—Do you refer to men in the Institute or to the men who are sent for training from outside?

A.2141. No, in the Institute here?—I have at present three Assistants who have been trained; they are all more or less, I should say, still under training.

A.2142. And are they to be sent abroad for training at any stage?—No.

A.2143. That is not the understanding at all?—No. One of my Assistants here was to have gone to America and I tried my best to get him the necessary permission and the grant, but we failed to do so.

A.2144. How long ago was that?—Four or five years ago.

A.2145. That is the only instance you have on record where an application was made to go abroad?—Yes, I think that is so.

A.2146. Would the people who are undergoing training under you here be fit to carry on the duties you are performing here?—I think you rather misunderstood me. The men I referred to are men who have been recently entertained as Assistants in my section.

A.2147. They cannot carry on the work?—They cannot carry on the work at present because they have been here for a very short time.

A.2148. Will they be fit to carry on at any period?—I cannot say; I am not a prophet.

A.2149. For instance, a man in Coimbatore who was Assistant to the Sugar Expert has been carrying on his duties there?—Yes. The present Government Entomologist in Coimbatore was my Assistant when I was there.

A.2150. Has any attempt been made actually to investigate the pests from which *sal* and *teak* suffer?—I do not do that here. That is done at Dehra Dun.

A.2151. Has anything been done to cure the fungus disease from which the mango suffers?—We have not done very much work here because mango hoppers are not important pests in this district. But a good deal of work has been done in the Punjab, in Mysore and in Madras.

A.2152. So far, I do not think that there is any radical cure for the mango pests, is there?—There is no specific remedy.

A.2153. It has not been touched here?—Not on any scale because, as I say, it is not an important pest here and we have not got the opportunities here for doing it.

A.2154. *Sir James MacKenna:* We hear a great deal about co-ordination of work here at Pusa. Do you not think that collaboration would be a better way of expressing the relationship between the different sections?—I do not think that there is very much in the term; it is the way in which it is done that matters really. What happens is this. If one expert wants certain information outside his sphere, he simply goes direct to the man who can give it and he discusses the matter with him informally. I really do not think that you would want a better system than that.

A.2155. The co-ordination or collaboration, whichever word you prefer, is you think, satisfactory?—Yes.

A.2156. Are you in touch with the entomological work done by the Indian Tea Association at Tocklai?—I receive their publications and sometimes Mr. Andrews comes to our meetings here and I have been to Tocklai as well.

A.2157. Does he consult you with regard to the identification of specimens?—No, because his work is largely on one insect. He himself has admitted that he gets very great assistance from us.

A.2158. What about the Imperial Bureau of Entomology in London?—We only give £500 a year. I recommended that India should contribute £1,000 but the Government would not contribute more than £500. One year they gave nothing; another year they gave £300.

A.2159. Are you of opinion that the Imperial Entomological Bureau is most useful?—Their abstracts of literature, particularly, are valuable to all workers.

A.2160. And therefore Government should continue this contribution?—Yes.

A.2161. *Sir Henry Lawrence:* Where is the Bureau?—In London.

A.2162. *Sir James MacKenna:* What is the position of the Government Entomologists in the Provinces? What Provinces have not got Government Entomologists?—Madras, the Punjab, and the United Provinces have them.

A.2163. What is your view about training in entomological subjects? Do you give short courses here?—We still give courses in lac and we have had various students lately for short courses. At present we have a man under training from the Punjab. But the short courses have been more or less abolished and we have to go up for special sanction to take in men for short courses.

A.2164. Could you give the necessary entomological training here which would qualify an Indian to be a Government Entomologist?—I think that it would be very difficult with the present staff and under present conditions.

A.2165. It would put more work on the Entomologist than he would be able to tackle?—Yes.

A.2166. Supposing an Indian were aspiring to become a Government Entomologist, what course would you recommend for his training?—It depends entirely on the man himself, as to what he knew already.

A.2167. What generally do you think, from your knowledge and experience, would be the type of man that you would like to get for such training? What sort of a training do you think would be most suitable as a set-off before he came to you for a specialised training in entomology?—I think that it would be an advantage if he had already had some experience in the Provinces before he came to us.

A.2168. For instance, take a course in biology. Do you prefer to get a man who has done a certain amount of spade work in the college?—What I meant was a man who had done work as an Entomological Assistant in the Province and not necessarily one who has been through the agricultural course. It depends entirely on the man himself.

A.2169. *Professor Gangulee:* From the point of view of equipment and from the collection of tropical insects that you have here in this Institute, do you not think that this Institute is one of the best in Asia?—Yes, I think so.

A.2170. Do you think that if you could develop this Institute you could attract students from various parts of Asia?—No doubt; you would certainly attract them. The bigger the place the more people you would attract and the better would the work be.

A.2171. You have shown us this morning the vast area that you are called upon to command, that is from the Malay States to Peshawar. In view of this vast area that you are able to command, is it not necessary to extend this department so as to meet that demand?—I have already put forward my views on expansion of entomology in India in my written evidence.

A.2172. Do you think that having made a good beginning it ought to be extended to meet that demand? Is that your considered opinion?—The demand for what? For training?

A.2173. For training, or to get information, and for entomological work generally?—I think, in view of the importance of entomology to India, it certainly should be expanded.

A.2174. You would not confine it merely to serve the needs of the Indian Agricultural Service or meet the needs of the Provinces? Would you look upon the problem from a wider point of view?—Yes, from the point of view of the country as a whole.

A.2175. And adjoining countries also?—We should have to collect information, as far as possible, from adjoining countries, but of course we could not expect to control them.

A.2176. Not for controlling insect pests so much as for educational purposes. Supposing students wanted to come from South Africa, would you take them? —Why not?

A.2177. You could take them?—Certainly, if they wanted to come.

I was thinking of the problem from the Empire point of view.

A.2178. With regard to the unsuitability of Pusa, you have stated that there are two difficulties, first with regard to the preservation of insects and second the rearing of insects, and you suggest that Coimbatore would be a suitable place. In what way, do you think, Coimbatore would be suitable?—It has a much more equable climate, and you can carry on rearing work practically all through the year.

A.2179. It is merely the climatic condition?—Yes.

A.2180. With regard to the rearing of insects, could you not reproduce the optimum conditions in your insectary? If you had a properly equipped insectary built, could you not obviate the difficulty about climate?—It would be very difficult to do that; it would be rearing things under unnatural conditions.

A.2181. In carrying out experiments here, do you collaborate with other departments?—When necessary, yes.

A.2182. You have to carry on some plot experiments, or field trials?—Sometimes. If I want to grow cotton on the farm, it is necessary to go to the agriculturist, to get a plot of ground, and perhaps get it planted. We used to do that when we reared parasites. We used to keep our cotton plants on the farm and let the boll-worm run riot on the plants, the parasite breeding on the boll-worm. We collected parasites and sent them up to the Punjab.

A.2183. What is the exact procedure of your following up the life-history of pests? You first discover the pest, for instance, and study the life-history in an insectary and then you reproduce the conditions in the field; is that the process?—More or less it is so; but discovery is a thing which perhaps takes years. We have been able to rear last year a caterpillar which we have known for 16 years, almost ever since I came to Pusa; we have found it very, very difficult to get it out, and it is only last year that we succeeded in doing so.

A.2184. As a result of 20 years' work, do you think you have now a survey of the insect pests which infest the major part of India?—We have a rough idea about it.

A.2185. Have you any idea as to the distribution of the pests?—We have the beginnings of information; I should like to say that we certainly have not got complete information.

A.2186. Do you think it would be useful to have a survey of that sort properly made?—I think it would be most useful; we have been trying to do it all the time.

A.2187. Perhaps you are not able to do it because you have not got adequate staff?—We certainly could do much better if we had a larger staff.

A.2188. Would you agree that that sort of survey could be undertaken in collaboration with the provincial departments?—We do undertake it in collaboration; we ask them to give us information. It is one of the objects of these Entomological Meetings that are held here, to get information and interchange of ideas, not merely between the Provinces and ourselves, but between the different workers in different Provinces.

A.2189. You have adequate information to put it together with a view to formulating a general idea of the distribution of the insect pests throughout the country?—We have a rough idea of it; I published a list of insect pests years ago.

A.2190. Merely from the point of view of distribution?—Distribution in space and also food plants.

A.2191. Are you trying to correlate distribution and incidence of insect pests with climatic and other factors?—That is a question of collecting data over a sufficient length of time for every insect. I hope, in future, entomological work will largely enable us to predict the outbreak of pests when we have got sufficient information. We might be able to say, for instance, that next year there will be a particular insect pest in Bombay, and we can take measures in advance. That means a good deal of work; it cannot come in our time; we can only lay the foundation.

A.2192. You have laid the foundation, and the next step ought to be that? —Yes, I quite agree.

A.2193. Would you tell the Commission any definite results obtained with regard to the control of insect pests, results which would enable you to go confidently to the cultivator and say "Do this and you will solve the problem"?—Such measures as control of grasshoppers by ploughing, and general agricultural methods like clean cultivation.

A.2194. Clean cultivation, spraying, and so on, are, of course, the ordinary platitudes of entomological control method. I want to know whether you have got something definite with regard to any insect pest in this country which will enable you to say "We know the life-history of this pest, and this is the method of control"?—For *Agrotis ypsilon* at Mokameh we used Andres Maire traps, and we found we could control it by that means.

A.2195. And you transmit that method to the provincial departments concerned?—Yes, that work was done in direct collaboration with the provincial department.

A.2196. *Mr. Calvert:* Have you done anything for the cotton boll-worm?—We have done a good deal on boll-worm and our information has been published.

A.2197. *Professor Gangulee:* Have you developed any new method of tackling the problem of the boll-worm?—Nothing new; Mr. Richards of the United Provinces is on the work at present.

A.2198. In my experience in Bengal villages, I found that the cultivators lose a great deal of their stored grains through weevils and insects. Have you done any experiments with regard to those insects?—I gave the Commission a copy of our bulletin on stored grain experiments.

A.2199. I have noticed that. But have you studied those weevils in detail here?—All that information is in the bulletin.

A.2200. Have you used any gaseous insecticide to control weevils?—No, that is not practicable on a village scale, under the conditions of an ordinary household.

A.2201. It is a practical proposition, perhaps, where large storage is concerned?—It is, for large storage perhaps; we have not taken that up so far.

A.2202. When you find a method of control here, do you ask the provincial departments to test that method? Supposing you are studying certain insect pests here and you find out the way in which they can be controlled, do you ask the provincial departments to repeat your experiments?—We do not ask them to repeat them; obviously, if we have found out a successful method, they will copy it; we do not need to ask them to do it, when they are quite willing to take up any methods which are successful.

A.2203. One has sometimes to suggest such trials and investigations; it may not occur to them at all?—We do not keep it secret; we let them know what it is.

A.2204. On the question of your relationship with the Veterinary Department, you have a department here, I understand, where you study insects responsible for carrying diseases?—It is not a special department.

A.2205. You do not study pathological entomology?—Yes, we go as far as we can.

A.2206. Are you in touch with the Imperial Veterinary Department?—Yes, I am.

A.2207. Is any work being done on collaboration with that department?—I am at present preparing a book on Veterinary Entomology for India.

A.2208. I understand lac-culture is a very important industry in this Province. Is any work being done with regard to that?—I should say a very large amount of work has been done on lac: we have issued a bulletin on lac-culture, for which there is a great demand at present; it has run through 4 editions. But with the starting of the new Lac Institute at Ranchi, it seems rather unnecessary to duplicate the work.

A.2209. You are in touch with the Institute at Ranchi?—Yes.

A.2210. Do you hold out any prospect for apiculture in this part of the country?—I think there is a very big outlook for apiculture, provided we get the staff to work it.

A.2211. How many students have you in your department for training?—There is one at present, and there is another coming from the United Provinces for systematic entomological training; we have had an application a few days ago asking if he could be sent over.

A.2212. How many more students could you accommodate in your section?—For how long a period?

A.2213. For 2 years?—I should think we could take 4, or perhaps half a dozen.

A.2214. Have you any students from the Universities of this country, wishing to take up entomology from a scientific or economic point of view?—We have had several men who came here for a short period, for a month or so, or perhaps longer.

A.2215. Do you think that method of the short course has stimulated interest?—I hope so.

A.2216. Are you in touch with the students who come here? Do you follow up your relationship? Supposing I come to you to be trained for a couple of months, would you have my address and send out entomological literature to me and so on? Do you have that sort of relationship established between the students and yourself?—I think it depends entirely on the student; if he likes to write to me and keep in touch with me, he can do so, but if he drifts away, he drifts away.

A.2217. You have said that there is no adequate interest taken in entomology; I take it it is the function of the Institute to create that interest?—We try to, but it is difficult to keep a large number of irons hot at the same time.

A.2218. *Mr. Calvert:* You ventured upon an estimate of the losses to India from insect pests. Have you any reason to believe that the percentage of loss in India is higher than in other countries?—I should not think it is higher than in other countries in the tropics, but it is certainly higher than in temperate countries.

A.2219. Higher than in European countries?—I should think so.

A.2220. The extra large staffs in European countries which you were mentioning this morning are not due to the fact that the loss from insects is greater, but to the greater interest in the subject?—I think that is so, on the whole.

A.2221. *Mr. Kamat:* You told us that the interest in entomology was not adequate in this country. Is that indifference general, or specific, and only confined to Indians?—Comparison is proverbially rather odious, but you must realise that a man who is really keen on insects is rather a rarity in all countries. Even in European countries, only a very small percentage of the population is really keen on insects, but you do get there a much larger proportion than you get in most Asiatic countries, except perhaps Japan, where there have been several men who are really keen on insects.

A.2222. I do not want to dispute the fact that the general interest taken by the Indian public is very small. But I want to go further and find out from you whether there are not other reasons for it. You sent up your proposal for an Entomological Bureau to the Government of India, and you also made an appeal to their hearts and imagination that the loss from insects to the crops of India was something like Rs. 200 crores, which is perhaps as big as the revenue of the Government of India; and yet they turned down your proposals. That shows that even the Government of India are rather indifferent to your science?—I quite agree with you.

A.2223. If the Government of India are so indifferent, we need not blame the Indian public?—I do not blame them a bit; I merely want to stimulate their interest and curiosity and so on in the science; and if I can stimulate the imagination of Government by appealing to their pockets, that is one way of doing it.

A.2224. May I further ask you whether you have found that the interest taken in insect life, as a hobby, by the Europeans in this country is any stronger than that taken by the Indians? Do you think that is a noticeable feature?—I think it is; on the whole, I regret to say it is so.

A.2225. They show a stronger interest?—I find more Europeans writing to me, wanting information about insects; they find something that appeals to them.

A.2226. *Professor Gangulee:* Europeans in their unofficial capacity?—They are mostly unofficial people, planters and all sorts of people; the Europeans write to me, and occasionally an Indian may do so, but not often.

A.2227. And therefore public opinion amongst the Indians to treat insect life as a hobby has to be stimulated by some method?—I think it does require stimulation. My book on "South Indian Insects" was printed in a fairly large edition for a book of that character, but all the copies were sold out. I cannot say how many copies were bought by Indians and how many by Europeans. But as the whole edition was sold out there must have been a certain amount of demand for it.

A.2228. *Dr. Hyder:* Did you ask somebody to have that book translated into some of the vernaculars in India? You know about 80 per cent of our people cannot read and the remaining have a purely literary education. You cannot expect them to have an interest in insects?—That book was published by the Government Press, Madras, and if any one wanted to bring out a translation I dare say they could get permission.

A.2229. Do you not think it is your business to stimulate that interest?—I am afraid I could not undertake translation.

A.2230. *Professor Gangulee:* How many copies were printed?—1,500.

A.2231. And sold in how many years?—They were sold out some years ago; within about ten years.

A.2232. *Mr. Kamat:* Considering the vast importance of entomology to the country and to agriculture, it is important that you should take steps to achieve publicity. What steps are being taken here at Pusa to give as much publicity as possible to this question?—We cannot do very much here. We hold these meetings.

A.2233. Do you take steps to send some of your results to the public press, or do you ask them to review or to bring to the notice of the lay public, any facts about entomology?—I do not send them; they receive copies of our publications.

A.2234. But then we know generally what it is in this country. Unless special attention is drawn to these matters the lay public is not likely to go into these indirect technical questions. I want to know whether you ask the Director of Information or the Government to arrange for a wider publicity of your results?—We have not asked the Director of Information particularly.

A.2235. You agree that it is necessary?—I agree. I have often said that a publication department should be attached here.

A.2236. If your results are to be of any value to the general public and much more so to the cultivator, you agree that it is essential for you to maintain here a sort of publicity department, or ask the Government to arrange better publicity than you are having now?—I have already suggested a publicity section in my scheme for an Entomological Service.

A.2237. Either through the Pusa Institute or through any other Government department, so that the whole country might come to know of the results arrived at here? What steps are being taken for a wider publicity?—I have not taken any special steps except that these papers are published and all Government departments and agricultural stations and so on get copies of our publications.

A.2238. You said something about the difficulty in the matter of touring expenses, a difficulty raised by the Finance Department. We all agree that there ought to be greater co-ordination. But I should like to know from you what it is exactly that you want the Finance Department to do. Is it that the Director should have some discretionary grants? What actual remedy would you suggest to counteract the effect of the present restrictions of the Finance Department or the Audit Department?—I think we should go back to the old system that we had when I came here.

A.2239. You mean, to allow you to spend on touring to an unlimited extent?—When I came here first Sir Robert Carlyle came down here and he told us that Government wanted us to tour in the Provinces as much as possible to make ourselves acquainted with local conditions. He said, 'Do not hesitate to tour; it does not matter about your travelling allowance.' Now the position is absolutely the reverse. We are not wanted by the different Provinces. We must not go there unless we are asked to go and when we do go there we find that we are out of pocket.

A.2240. That means you want a sort of *carte blanche*?—That was what we had in the old days and I do not think it was found there was any unnecessary expenditure.

A.2241. As the old days have gone now, I want you to suggest a better method of securing some latitude and I want to ask you who should be given discretion to determine whether an officer should go to the Province to coordinate the work or whether the provincial officers should come up here, the Director or the Ministers in the Provinces? And should they be allowed to spend money on travelling allowance to an unlimited extent or should there be any limit placed by the Audit Department? Have you got any definite suggestion to make?—I think it should be largely left to the discretion of the Head of the section here as far as the touring of that section is concerned.

A.2242. That is, if the Director here thinks that a visit by you, say to Bombay, is absolutely necessary, his word should be final and the Finance Department should have nothing to say?—I do not think the Finance Department would object if the Director personally considered that the tour was absolutely necessary.

A.2243. I should like to ask you about the conditions of service of your Assistants and how they are recruited?—That is one of our difficulties at present. The grade of Assistants here starts at Rs. 100 a month and rises slowly by increments of Rs. 10 a year up to a maximum of Rs. 300. Under modern conditions you can get the men, even some M.Sc.'s, on the money; but either they are not good men or they are men who come here because they cannot get a better job elsewhere, or else they are good men who just come here for the benefit of cheap training as Assistants and then go off somewhere else afterwards. We have great difficulty in attracting good men and keeping good men under those terms.

A.2244. You emphasise therefore that the starting salary for your Assistants, and their prospects ought to be improved if your work is to develop properly?—Yes; I consider it essential.

A.2245. *Sir Henry Lawrence:* You have suggested that your work should be transferred to Coimbatore. I understand that you wish to have your work cut off from other branches and have a separate Entomological Institute?—Yes, to do not only agricultural work but also all other entomological work.

A.2246. You think there will be no inconvenience from being in a different site to the other branches of agricultural research?—No, I think the advantages of transfer would outweigh any disadvantages.

A.2247. Your selection of Coimbatore is not final? You have lived there?—That was all discussed a great deal. Coimbatore is not an ideal place but it is the best place I know of.

A.2248. What are the primary conditions that you would desire for a successful institute?—I want a place where you can rear insects all the year round, a place with a good climate and also suitable for preservation of collections.

A.2249. Those are the three essential conditions?—Yes.

A.2250. You should be comfortable?—I mean, if you live in a decent climate you can get better work done.

A.2251. And your specimens should be preserved?—Yes.

A.2252. What about the accessibility to other parts of India?—In a great country like this that does not matter so very much and such a thing will, in the near future, be solved by aërial transport.

A.2253. So that you do not think that you should be within easy reach of one of the great sea-ports, say Bombay or Calcutta?—Coimbatore is within quite easy reach of Madras which is one of the sea-ports, and also of Tuticorin.

A.2254. Are you in touch with the college recently established in Trinidad?—No; we are not in special touch.

A.2255. Are the insect pests there of a similar character to what you have here?—I think that they are practically all different.

A.2256. So that the title, 'College of Tropical Agriculture,' does not refer to India?—It would not cover most of our pests. Theirs are different from ours.

A.2257. Have you any knowledge as to the size of the entomological staff there?—I have not any first-hand information; I know there is an entomologist.

A.2258. Have you not got the particulars in your records here? Could you not get them for us?—No, I do not think we have any information here.

Mr. T. Bainbrigge Fletcher.

A.2259. Have they not published any works?—I have not got anything myself; there may be something in the library.

A.2260. What is the total budget of your section?—Roughly, about Rs. 75,000.

A.2261. In the scheme you put in in 1920, you asked for a budget of Rs. 7 lakhs?—About that amount. You must remember, however, that that scheme includes all entomological work, whereas my budget here only includes Pusa, and not the other 12 entomologists who are working in different parts of India at present.

A.2262. Rs. 7 lakhs would be sufficient, in your opinion, for the entomological work of all India?—That is my budget estimate.

A.2263. What do you mean by that?—I am not a financial expert; I have only worked out the figures roughly, but that is about the amount it would cost.

A.2264. You show on that budget 29 experts at Rs. 1,000?—That is a sort of average pay. Some would be drawing more and some less.

A.2265. Is that on the assumption that the staff will be European or Indian or both? What was your plan?—I took it that that would be an all-round figure for a general average.

A.2266. With a mixed staff?—Yes.

A.2267. But you would not be able to recruit for a cadre of that character in India for some considerable time to come?—I calculate it would take 10 years to work up to a staff of that size.

A.2268. You were asked just now whether you could point to any definite results of your work. Can you point out anything which you have shown which would have saved expenditure on the part of the Government if it had been known earlier? If any of your results had been known earlier, would they have prevented the waste or unnecessary expenditure of public money? To take an example, I was under the impression that in Madras the flea of the rat had been shown to be of a different variety to the flea which carries plague. Is that correct?—Yes. The fleas in Madras are *astia*, whereas the ordinary rat flea is *cheopis*. The latter carries the bacillus of plague; the former hardly carries it at all. I thought you were referring to things done here; we did not discover that fact here.

A.2269. Whom was that discovered by?—The flea was described by Rothschild, I think.

A.2270. That is the kind of information which could prevent the waste of public money?—Yes. A lot of trouble was taken at the time to prevent Madras being infected with the plague.

A.2271. There was very heavy expenditure on the destruction of rats, which was wasted, for this reason?—I think the destruction of rats is always advisable; you save money by avoiding the damage they do.

A.2272. That is a totally different question?—I have not any first-hand information as to the amount of money spent to keep plague out of Madras, but I know there was a tremendous number of regulations in force.

A.2273. I am trying to get from you, by means of an illustration, what the advantage of systematic entomology is. This is an illustration?—Yes, this is a case which proves the value of systematic entomology. There is a very minute difference between the two fleas, but the fact that there is this distinction makes all the difference with regard to the carrying of plague.

A.2274. From that would you infer there are other cases where other insects have been attacked owing to lack of accurate, systematic entomological information?—There have been such cases, undoubtedly.

I want you to give us something definite on which you can recommend this expenditure of Rs. 7 lakhs a year which you have asked for. If you can give us some illustrations it may help the case.

A.2275. *The Chairman:* You can put them in later, if you like?—I think it would be better; I may have to criticise other people's work in some cases.

Mr. T. Bainbrigge Fletcher.

A.2276. *Sir Henry Lawrence:* You will put them in later?—Yes.*

A.2277. *Sir Thomas Middleton:* Continuing the subject Sir Henry Lawrence has raised, you estimate the losses incurred in India through damage done by insects at roughly Rs. 200 crores. You agree, of course, that even with the most perfect Entomological Service in the world it would be impossible to prevent more than a fraction of that loss?—Yes.

A.2278. But there must be a very considerable fraction which is preventable?—Yes.

A.2279. Recognition of that fact has led, in recent years, to the extensive development of the control of insect pests in the United States and Great Britain?—Yes.

A.2280. It is unlikely those countries would have gone to that expenditure unless they found it profitable?—I think there is no doubt they have found it profitable. They have realised the importance of it and increased their staffs accordingly.

A.2281. You contrasted, in reply to some previous questions, conditions in Europe with conditions in this country. Do you agree that amongst scientific workers in Europe the entomologist is particularly fortunate in having a larger number of voluntary workers to assist him than is the case with many other sciences?—That is so to a large extent because economic entomology is a comparatively modern science. The real science of entomology has been built up in the past purely by voluntary workers, and there is still a very large proportion of voluntary workers.

A.2282. That voluntary work begins in most English schools; in most English schools you will find butterfly nets and so on?—Yes.

A.2283. It begins with the boys and is continued?—Yes, in some cases, but not always; some people take it up in later life.

A.2284. The case of the Madras flea has been mentioned. Rothschild was a voluntary worker of some note, I think?—Yes.

A.2285. You have pointed out that a similar interest does not exist among the general public of this country, and therefore you indicate one must rely to a greater extent on official assistance. I think that is your argument?—That is so, generally speaking.

A.2286. How many official entomologists have you at work in India?—About 13 at present.

A.2287. Would you care to give any indication of the number you would like to see at work?—There is practically no limit to the amount of work.

A.2288. What is the scope in India?—The scope is absolutely unlimited, at any rate in our generation.

A.2289. If the scope is unlimited, we must begin with the training of suitable persons. How would you proceed to train them? You have indicated that 2 years at Pusa are useless for the type of student that is sent to you?—That is so, because the type of student who is sent to us has no knowledge whatever of the subject when he comes.

A.2290. What is the knowledge you desire him to have when he comes?—If he is really keen on insects I do not want much more to start with, but you cannot turn him out in 2 years even if he is keen.

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* Two instances may be given to show the value of systematic work and the necessity for this to precede applied work in Entomology.

In the first instance, the various borers in sugarcane, maize, *juar*, rice and other cereals were lumped together under the name of "moth borer" (*Chilo simplex*) and recommendations were made for the growing of maize as a trap-crop for borers in sugarcane. Subsequent investigation has shown, not only that the borers in sugarcane, maize, etc., are quite different, including over a dozen species with distinct habits and food-preferences, so that no one method can possibly control them all.

A second instance may be found in my *Report of the Second Entomological Meeting*, Pusa, pp. 196-197.

A.2291. If you want a good educational basis, what should you have? What is the normal training for an entomologist? Is it not a degree with zoology as the main subject?—Yes, nowadays that is about it.

A.2292. As you know, we have in Britain in the past 10 or 15 years been training entomologists, and we select for training persons who have taken an honours degree in zoology?—Yes.

A.2293. Can you not get men of that type to train in Pusa, men who have taken a science degree in zoology in an Indian University?—As I said just now, the only student who has done his 2 years' post-graduate course here was an M.Sc. in zoology, and he came here knowing nothing about entomology at all.

A.2294. *Sir Henry Lawrence:* What pay did you give him when he was here?—None. He had to pay Rs. 25 a month for his training.

A.2295. *Sir Thomas Middleton:* You referred to the question of salaries, and some emphasis was laid on the amount of the starting salary. Do you not think that in a subject of this sort prospects are more important than the starting salary?—I think the present starting salary is too low and the rate of increment is too slow.

A.2296. You indicate that entomology covers not only agriculture proper but forestry, veterinary and medical questions. Is there any real objection to the separation of the forest work and your work here in Pusa? Is not there work enough for both of you?—There is plenty; the only point is the avoidance of unnecessary duplication.

A.2297. Is there unnecessary duplication?—I think there is. Government has the expense, for instance, of keeping up two big libraries on entomology.

A.2298. Are there any other objections?—There is the keeping up of two collections. Very often the insects they deal with there are the same as are being dealt with here.

A.2299. I do not quite follow the reasons which lead you to select Coimbatore as against Pusa? If you compare Pusa with the places in which European entomologists work, you are in a much better position?—I would ask you to come here in 6 months' time and ask you if you would like then to put it in that way.

A.2300. I am not talking of you but of your insects; in 6 months' time the conditions are very favourable for your insects?—I do not think we are much better off here; insect activities practically close down in October till about the end of February; then we get a short outburst of activity about the beginning of March and after that they close down again until the advent of the monsoon.

A.2301. There is no lack of activity in the monsoon?—No. Then of course in the monsoon you get intensely damp conditions and when rearing insects, their food often goes mouldy.

A.2302. Comparing your conditions with other entomological conditions, I cannot think that the locality imposes very severe restrictions upon you. Have you worked in laboratories in Britain?—Yes, I was working there last winter for 6 months.

A.2303. Your conditions so far as the study of living insects is concerned must be better here than they are there?—Perhaps, but they are not the best we can get in India.

Yes, it may be that they are not the best conditions but they are good.

A.2304. *Dr. Hyder:* You require a regular Entomological Service after the approved models of other services, such as the Police, Agriculture, and so on?—I think the Geological Service is more the type one might keep in mind.

A.2305. Have other countries got such a regular service?—Yes.

A.2306. Are you aware of other countries that have definite conditions as to personnel, pay, promotion and pension?—The United States, of course, is the best example.

A.2307. Has England got such a service?—It has, on a very small scale as compared with other countries.

A.2308. With regard to this loss of 200 crores, do you claim accuracy for your figures?—I claim they are as sufficiently accurate as I could make them.

A.2309. One could not add another 200 crores to it?—No, I went carefully into the outturn of crops, the areas under crops, and we took the valuations as far as we could from the market prices and so we got a rough idea of the value of all the crops grown in India, and then we took the losses on each crop.

A.2310. You speak of dissatisfaction prevailing among entomological workers; does that dissatisfaction extend to both higher and lower grades?—I do not think we are too satisfied with conditions.

A.2311. Conditions of pay and prospects?—Yes.

A.2312. What is the difficulty with regard to obtaining rare books?—Very few copies of the older books come into the market; there were very few copies originally and most of them have now gone into public libraries, so that it is very rarely that a copy is obtainable. When such a book is offered by a bookseller, under the Budget Rules I may or may not have money at the time. You cannot foresee when one of these books that we want will be available; when it is available, if we have no money we cannot get it, and by the time the money is made available the book may be unobtainable. What we want is to have a definite sum that we can lay our hands on at once and buy straight away without any red tape.

A.2313. Are you not given a definite grant for the purchase of books?—Yes, but it lapses; what I want is a definite sum that will not lapse.

A.2314. With regard to this difficulty as to conducting examinations, why should you not visit the agricultural colleges and sit on their committees dealing with courses and examinations?—Because if I go to attend an examination, nowadays the Province in which the examination is held has to pay my expenses, and they will not do that; they will not ask people in from outside if they have got to pay their expenses.

A.2315. Do your remarks apply to Indian Universities as well as to the Government Agricultural Colleges?—The Agricultural Colleges; I have had no experience of examining for the Universities.

A.2316. The Agricultural Colleges will not pay your travelling allowance; they are far behind in this matter as compared with the Indian Universities. For instance, an Indian professor stationed at Peshawar will do examining work at Calcutta?—In the old days I used to go down particularly to the Central Provinces and Madras; every year they asked me to go down and do their examinations. It meant that I kept in touch with the teaching work there; it also gave me an opportunity of going round and seeing what they were doing, giving any advice or information and getting information myself; I think it was of mutual benefit to all concerned.

A.2317. With regard to your suggestion as to giving a short course of lectures at these provincial agricultural colleges where entomology is a subject of study, do you think you could do much in a year? I do not think your idea is to hold the course for a full academic year?—No, I think you have altogether misread what I say. What I suggested was that if we had a properly organised service, it would be the duty of one member of the staff to go round to these various colleges and give short courses, not for a year but for about a month at the outside at each college. That would not replace the present courses but would supplement them. The provincial agricultural colleges would carry on their training courses, which you must remember are for agricultural students and not for entomological students. They get a smattering of entomology, but in addition to that the Central Institute would send out a special lecturer; he would have all the latest information about all pests, he would have specimens, diagrams, films, and everything of that sort. You could get it very much better done if you had one man going out from a central place, and he would give the students a separate extra course to supplement the local information which they will have derived from their own staff.

A.2318. Are you familiar with the courses of study at these provincial agricultural colleges? Does entomology form a subject of study at all these colleges?—A certain amount of it, yes; I was two years at Coimbatore.

A.2319. It is taught in the first two years, is not it, at all these provincial colleges?—I would not like to say it is taught in the first two years at all of them, because the courses vary from one college to another; but generally speaking they get a certain amount of entomological instruction during their agricultural course.

A.2320. Would you like entomology to be a subject of study at these provincial agricultural colleges?—It is already; they give a course of training in entomology in their course of agriculture.

A.2321. I thought you said entomology did not figure as a subject of study at these provincial agricultural colleges?—No, you have misunderstood me; I did not say so at all; it is part of the training.

A.2322. Now with regard to this matter of the education of the ryot, who is, after all, the chief man, apart from the service and the collection of books and other matters, what measures would you suggest?—That I think is a matter purely for the local department; it is for the local department to do that local demonstration and propaganda work.

A.2323. Let us go through this matter step by step. You think it would be a good thing to have a readable primer on common Indian insects, in the vernaculars of the different Provinces, for the education of children?—I think a primer on insects would be rather too much of a mouthful for them all at once, but if you had a few facts about insects in their ordinary reading book, that would be a good thing.

A.2324. If you do not agree with that, what would you suggest for the education of the adult ryot who cannot read or write but who knows he incurs losses on the crops he grows?—As I have said, that is a matter for the local departments, but, generally speaking, they should be able to send demonstrators round to the ryots to explain these things to them, as they cannot read or write. That is being done.

A.2325. *Professor Gangulee:* Would you like to see entomology a subject taught in the Universities of this country; would it help your work very much?—Yes, we have already passed a resolution to that effect at the last meeting.

A.2326. Do you consider it a very essential step towards obtaining suitable recruits to your department?—I say we have already passed a resolution to that effect, but, like most resolutions, it has not gone any further.

A.2327. With regard to the point raised by Sir Henry Lawrence as to the saving that may result from entomological investigations, is any work being done to prevent damage being caused by insects to railway sleepers, Army stores or grains in elevators?—We carried out some experiments here on the treatment of wood against termite and those results were published; considerable work has been done at Dehra Dun by the Forest Economist on that subject.

A.2328. Was that work drawn to the attention of the Railway Board?—It was done at the direct request of the railway people.

A.2329. Would there be a considerable saving if your method of controlling termites could be adopted?—As I say, we did some work here and our results corroborated those arrived at at Dehra Dun.

A.2330. With regard to popularising entomology, have you at any time received requests from the Department of Education in this country to utilise all your beautiful charts, graphs, coloured plates and so on?—We have had a large demand at various times from different schools; I could not give you the list of them off-hand.

A.2331. The demand is there?—Occasionally.

A.2332. Have you thought out the problem of utilising the cinema for popularising the study of the insect life cycle?—We have thought of it.

A.2333. But nothing has been done in that direction?—No.

A.2334. You think the cinema would be a suitable medium through which the subject of insect life could be made popular?—Yes, I certainly think it could; I suggested that in my note on publicity of which you have a copy.

A.2335. Do you find the administrative duties of your section hamper you in any way in your research work?—They take up most of my time.

A.2336. *Sir James MacKenna:* Do you anticipate any difficulty in reviving the Sectional Meetings in entomology?—No, I do not anticipate any difficulty. We should have had a meeting two years ago; it was arranged. I wrote around the Provinces and told them we were going to have a meeting and one or two papers were sent in; then I was ill and was unable to hold it.

A.2337. I ask the question because we have been told that the Devolution Rules and travelling allowance troubles have rather tended to wreck that scheme?—Those rules have rather arisen since we had a meeting; I cannot say what the effect would be on the next one, but I hope to continue them; I do not see any reason why they should not continue.

A.2338. The Government of India have not given an expression of opinion in the sense of discontinuing them on account of expense or anything of that kind; they have not been involved in the retrenchment policy?—No.

A.2339. Of course you consider them to be extremely important; I know you started the idea in Pusa?—Yes, I consider them to be very useful; at the last meeting there was a resolution passed to the effect that they should be continued.

A.2340. Biennially or trienially?—Biennially.

(The witness withdrew.)

Dr. W. H. HARRISON, D.Sc., Imperial Agricultural Chemist, and Joint Director, Agricultural Research Institute, Pusa.

Replies to the Questionnaire.

QUESTIONS 1 AND 4.—Questions 1 and 4 relating to research and administration are so closely inter-related that it is difficult to deal with them individually. The factors which have to be considered in formulating suggestions relating to the administration and co-ordination of the agricultural activities of the Governments in India are the same which have operated to bring about the present situation in regard to the organisation of research, and they bear equally upon any suggestions for the advancement of the latter. A review of the factors which have so far guided the course of events seems therefore to be a necessary preliminary to the formulation of proposals for future improvement.

Taking first the organisation of the Departments of Agriculture in India, it may be noted that previous to the year 1904, an Indian Department of Agriculture was practically non-existent. That year marked the inception of a scheme from which agricultural development in the All-India sense originated. Agricultural Departments staffed by the I. A. S. officers specially recruited for the purpose, were developed in each Province and a central department was created directly under the Government of India, the underlying idea being that whilst the provincial departments would be concerned mainly with the study and development of local agricultural conditions, the central department would take a more general view of agricultural problems and act as a co-ordinating and advisory body. This latter function was strengthened by the establishment of a Board of Agriculture for India to meet annually with the object of giving the experts an opportunity of exchanging ideas with one another, of learning what is being done in the various Provinces, of co-ordinating their work and advising on agricultural administration generally.

The central department was staffed by senior officers who possessed considerable experience of Indian or tropical agriculture, whereas the provincial departments were staffed mainly by junior men possessing little or no knowledge of tropical agriculture, and often recruited direct from the Universities. As a consequence, in those early days, the central department readily fulfilled the functions laid down and formed a real centre for the activities of whole department.

The provincial departments were staffed with Agriculturists, Chemists and Botanists, who were in most cases supplied with full facilities for carrying out their duties, and experience rapidly accumulated. This experience being mainly local in character was not shared by the officers of the central department, and thus the first intimate relations between the two branches tended to lessen as time went on. With the growth of the department, the Board soon became unwieldy and it was no longer possible to collect all the members of the Agricultural Departments together for the meetings and, in 1908, the membership had to be reduced with the result that the scientific experts in particular rarely came into intimate contact with their colleagues in other Provinces. Later on the meetings were held biennially instead of annually and discussions of the programmes of work of the various departments were dropped. None the less the co-ordinating influence of the central department still persisted in an effective but voluntary form.

With the inception in 1919 of a scheme of general expansion, which aimed at making the expert staff of each Province complete in itself and capable of dealing with all local problems of immediate importance, the provincial departments developed a tendency to adjust themselves into independent units and this movement received an impetus through the introduction of the Devolution Rules, 1920, framed under the Government of India Act, and the classification of Agriculture as a Transferred subject in the Provinces.

As a sequence to the decision to treat Agriculture as a Provincial subject in charge of Ministries, the central department could no longer exercise the same influence over the development in the Provinces as hitherto, and discussion of matters relating to agricultural administration in the Board of Agriculture necessarily became restricted. The waning influence of the central department suffered a further check through the concessions made by the Lee Commission, especially—(1) The introduction of selection grade posts into the department removed the financial attractions which had led to recruitment to the central department from the most capable of the provincial officers, and further when these selection posts were given to officers before the completion of the full 15 years' service, the attraction of service in the Provinces became greater than with the Central Government. (2) The grant of the right to take proportionate pension to officers serving under Provincial Governments and the withholding of this privilege from those serving substantively with the Central Government stopped all hope of recruitment to the latter service, for not only was no officer prepared to forego the privilege by accepting service under the Government of India, but, in addition, as the concession led to an immediate resignation of many of the senior men, the prospects of promotion, with all its attendant advantages, became far better in the service under Provincial Governments.

These concessions prevented recruitment to the central department of experienced members of the provincial departments, while, on the other hand, the scheme of Indianisation of the department not only resulted in the cessation of further recruitment to the I. A. S., but also in the appointment of recruits with little experience to the new and vacant posts at Pusa recently placed outside the cadre of the I. A. S., who can have little immediate influence with provincial departments staffed by senior and more experienced officers.

(3) Further, the principle that any services rendered by officials of the Central Government to a provincial department are liable to form a charge on the latter has had an appreciable effect in restricting co-operation between the central and the provincial departments. All these factors have combined to produce a line of cleavage between the several Agricultural Departments in India, have led to an increasing isolation of the central department and have removed hope of a continuation of central influence under existing conditions to a remote distance.

The central department, however, still exercises a certain modicum of influence through Muktesar, the Imperial Institute of Animal Husbandry and the Research Institute at Pusa but only—apart from the personal influence of any individual officer—through those activities which any particular provincial department may be deficient in, or devoid of. It has practically no influence, if one excepts the publication branch, in co-ordinating the activities of one Province with another. From the agricultural point of view the provincial departments are practically independent entities, owing no allegiance to India as a whole, and the wider view of the general progressive well-being of Indian agriculture and the international relations of Indian agriculture is, therefore, in grave danger of submersion.

The central department which has under its purview these wider considerations is thus left stranded as an isolated body unable fully to exercise that influence which is its prerogative.

The necessity for the central department being placed in an advantageous position for the due performance of its responsibilities requires little demonstration and it is apparent that some organisation must be created which will enable the central department (1) to keep in touch with the work done by the several Departments of Agriculture, (2) to give advice and formulate definite policies of development, (3) to promote all schemes which make for the general advancement of agriculture in India, (4) to stimulate and increase the volume of research work annually produced particularly in relation to problems which are definitely not local in character, and (5) to be in a position to take prompt and effective measures to prevent the introduction of crop pests and diseases from outside India and also from one Province to another.

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What seems to be required is an organisation which will promote free co-operation between those engaged on identical or allied work and not a central co-ordinating body so frequently associated with central control which cannot prove acceptable to departments and ministries who have been granted provincial autonomy. Any organisation to prove successful must obtain the voluntary support of the departments and in fact be of such a character that they will willingly seek its co-operation, help and support.

Several suggestions have on occasion been put forward, the most prominent one and the one which first naturally comes to mind through obvious analogies, is the institution of an organisation based on lines closely following that which has been evolved in the United States of America. This is essentially one of a strong Central Federal Department working in close co-operation and contact with the various States departments, but a close examination leads to the conclusion that such an organisation cannot be successfully transplanted to India in present circumstances. Apart from the obvious serious financial burden which would be thrown on the Government of India, the outstanding feature is that the Federal Government in the United States of America exercises an executive and administrative control over many Government functions throughout the whole of the States, (*e.g.*, the passing of the Grain Standards Act which aims at bringing about uniformity in the grading of grains; the Federal Reserve Act which authorises national banks to lend money on farm mortgages; the Federal Farm Loan Act which created a banking system suited to the farmers' needs; the Food and Drugs Act which forbids adulteration; the Hatch Act and the Adams Act which make provision for grants for furtherance of agricultural research and education).

The Central Department of Agriculture therefore functions continuously throughout the whole country and thereby is in intimate contact with local conditions. No similar system of legislation is in operation in India and neither under the present system of devolution and administration of transferred subjects does it appear probable that it will originate in the near future. Consequently, the formation of a Central Department of Agriculture, based on the model of the United States of America would be largely inoperative in that it would carry with it no real bridge between its sphere of operations and that of the provincial departments. If and when a system of Federal Government is developed in India, then the proposal might be more seriously considered. Until such a change comes about, some simple and less ambitious scheme must be adopted.

Another proposal is that all agricultural research in India should be carried out under the aegis of the Government of India. This would connote the taking over by the Central Government of all the research activities of the Provincial Governments, thereby relieving the latter of present serious financial commitments and permitting them to apply the funds thus liberated to direct agricultural development. Consideration, however, shows that unless the Government of India were prepared to meet a very considerable additional expense in developing the scope and cadre of their present department, there would be no immediate increase in either the volume, kind or scope of the research work turned out and that most of it would still continue to be strictly local in character and application. Advance in agricultural research and knowledge will not be acquired by merely transferring the present onus of the Provinces on to other shoulders, but by developing the present situation. The proposal does not do away with the necessity of a bridge between the activities of the central and provincial departments. All it does is to transfer the present gaps between the departments to points more remote and localised, *i.e.*, between research officers working on local problems and the agricultural officers responsible for the development of local agricultural operations.

From a consideration of the above it becomes clearer that the required organisation must be supplementary to the existing one, which is quite capable, under able administration and control, of covering the general requirements of a Province, so that being independent of provincial boundaries it can consider agricultural problems in a wider sense, can carry on investigations covering broad agricultural areas, crops and problems, and by the provision of suitable means can give effective help, either financially, or otherwise, to provincial departments as occasion arises. Without interfering with local administrative problems and without resorting to executive orders, it must be able to obtain the co-operation of the Provinces by the beneficial character of its functions. Fortunately in India we have an example of such a central organisation in the Indian Central Cotton Committee and its activities point the way to a satisfactory general solution of the problem. This body is of recent formation, yet in the brief period of its existence it has been able to influence in a most marked manner the improvement and development of cotton interests throughout India, and that with the willing co-operation of the provincial authorities concerned.

The organisation and activities of this Committee will have been placed before the Royal Commission in full detail and there is no necessity to refer to them here except briefly to state that in each cotton Province there is a Provincial Cotton Committee composed of all interests, which is in direct communication with the Central one by means of representatives. The latter therefore represents all interests throughout India and is in a position to consider problems from a very broad standpoint and thus exercise a very real influence. In addition the Central Committee has funds at its disposal obtained through the cotton cess and these funds are utilised for the furtherance of research on cotton investigations of all types. It maintains its own research institutes and affords facilities for carrying on and extending the work done by the provincial departments. It is in fact a live co-ordinating force in regard to cotton problems and this co-ordination is not brought about by compulsion but by inducing co-operation.

In the Indian Central Cotton Committee appears to lie the germ of future successful development of all Indian agricultural research and of inducing active co-operation between the Provinces themselves and between the Provinces and the Government of India by fostering the formation of similar central bodies specially to deal with the major crops and agricultural problems of India and in direct control of the Government of India, but given a certain freedom in the use of the funds allotted to them. Such committees would be at liberty to run their own research stations and be in direct contact with similar provincial committees thus co-ordinating the work of several Provinces.

Such an organisation has the great advantage that only the most urgent and important subjects would be considered in the first instance and as funds and opportunity permitted, future extensions could be made. It would be in fact a fluid organisation capable of being developed as the needs and interests of Indian agriculture opened out. Among the outstanding subjects first to be considered are:—(1) such crops as wheat, rice, oil-seeds, sugarcane, fibre crops, tobacco and the major cereals and pulses, (2) the problems of crop protection both internal and external, (3) agricultural engineering and irrigation problems, (4) agricultural economics, finance and co-operation, (5) animal husbandry and dairying.

The financing of the several committees would have to be arranged on varying lines, some might be financed by export duties or cesses, some probably by provincial contributions and others directly out of the central revenues, but in all cases it seems necessary that funds should be at the disposal of the individual committee subject to such general rules as are considered desirable.

A scheme of this character would result in co-ordinating the work of the Provinces with research promoted by the central authority, yet a further provision must be made for co-ordinating the activities of these several separate organisations within the purview of the Central Government. To bring this about it is suggested that the readiest method is to constitute a permanent Board of Agriculture directly under the administration of a Member of the Executive Council consisting of a few experienced members selected for their ability and knowledge, each dealing directly with a definite portfolio, and each being in direct contact with the appropriate central committee or committees. I would suggest the following arrangements as suitable:—

1st Member deals with Animal Husbandry and Dairying and Veterinary.

2nd Member deals with Plant Industry.

3rd Member deals with Crop Protection.

4th Member deals with Agricultural Economics including agricultural co-operation and finance.

5th Member deals with Irrigation and Agricultural Engineering.

Such an organisation can reasonably be expected to play a very important rôle in the sphere of internal development of the agricultural resources of the country and appears almost indispensable in the circumstances ruling at present. An advisory committee to replace the present Board of Agriculture and to consider the general aspects of Indian agriculture can be formed by representatives deputed from the several committees and the members of the permanent Board of Agriculture.

The points raised in the Questionnaire may now be dealt with *seriatim.*

QUESTION 1.—RESEARCH.—(*a*) Under the provisions of the Devolution Rules, 1920, framed under the Government of India Act, 1919, Agriculture is a Transferred subject and the organisation, administration and financing of agricultural research in the Provinces has now devolved on the Ministers who are responsible for them to the Provincial Legislative Councils. The Government of India exercises no control over these provincial departments which concern themselves solely with the agricultural development of the Provinces, and with agricultural research which, in general, has a definite bias determined by local conditions and crops. The development of these provincial departments consequently will be determined mainly by purely provincial considerations which do not fall within the immediate purview of the Government of India who are responsible only for central research on problems of All-India importance.

The activities of the central department at present cover a fairly wide field, namely, general research on chemistry, bacteriology, mycology, entomology, the raising of improved crops, breeding of new varieties of sugarcane, investigations connected with animal husbandry and dairying, animal nutrition, control of animal diseases (and one may also include here the activities of the Indian Central Cotton Committee) and serve as a basis for supplementing the work of the provincial departments. Many agricultural problems in India are not confined by the limits of political boundaries but are spread over several Provinces and it is to such problems that the energies of the central department should be mainly directed.

Hitherto, the organisation of the departments has in general followed the stereotyped lines of providing a staff comprising agriculturists, botanists, chemists, etc., working semi-independently of one another and confining their attention to subjects clearly identified with their special knowledge. Owing, mainly, to the comparatively small number of experts available, there has been no systematic attempt to associate them on definite lines of research, but when some pressing problem has presented itself for investigation such associations have been brought into operation either by the administrative Heads of the departments or by voluntary co-operation of interested experts. These associations have been of a temporary character and have been dissolved when a solution has been attained, but the position now developing would appear to indicate that future organisation must aim at associating various experts on a definite problem or group of problems. As the central department is to deal with the development of research of more than local importance, it would seem desirable to organise it on these lines. A central organisation for the administration and financing of agricultural and veterinary research throughout India on lines which have proved efficacious in some advanced countries does not appear possible under the existing conditions brought about by the Reforms as there is every likelihood of the Provincial Ministers and the local Legislative Councils strongly resenting any outside interference in local matters, and neither does it appear desirable that the Central Government should assume responsibility for the conduct of all research carried on throughout India.

It is suggested that this object can be attained most readily by adopting and developing the ideas leading to the formation of the Indian Central Cotton Committee, namely, by creating a number of similar central committees each dealing with a clearly defined field of investigation and provided with adequate funds for carrying on the work. Each committee would be intimately associated with provincial committees and also with a permanent Board of Agriculture comprised of a few experienced officials. There would thus be evolved an organisation whereby the provincial departments would maintain contact with each other and the central department. Research would be fostered by recruitment of special staffs, thus increasing the number of expert officers employed under the Central Government and permitting assistance being given to provincial departments whenever considered to be necessary. Such assistance should be paid for out of central funds, even when applied for by a local department, otherwise the present tendency for isolation will be continued.

For several years following upon the formation of the Indian Agricultural Department, the meetings of the Board of Agriculture afforded facilities whereby the scientific experts were enabled to meet together and discuss their problems and difficulties. Subsequently the restriction of the membership prevented this occurring with the result that these experts only rarely come into intimate contact with their colleagues in other Provinces. To remedy this state of affairs, sectional meetings of the Board were instituted, but after a few years financial difficulties rendered it extremely difficult to bring together a fully representative gathering and the scheme has been in abeyance during recent years.

The suggestion that central committees should be instituted to consider broad agricultural problems appears to offer an effective mechanism whereby the present state of affairs can be remedied and research officers brought into intimate personal contact with their colleagues and others working on similar problems. If financial considerations should offer an obstacle, then the expenses involved should be borne by the central authority.

Whatever may be the ultimate organisation of the central department, it appears desirable to institute one change in the immediate future. For many years the Pusa Institute was the only one under the Central Government dealing with broad agricultural problems and those connected with cattle-breeding naturally received considerable attention. Valuable results were obtained and the scope of the work was expanded. Until now the farm portion is devoted almost entirely to the raising of fodder crops for the herd with the result that the major staple crops of India are not cultivated. This Institute is staffed by expert officers whose interests are mainly centred on the latter type of crops and the cultivation now practised therefore only partially fills their needs. This being the case the transference of a portion of the cattle-breeding operations to the recently acquired farm at Karnal seems to be desirable, or alternatively to extend the culturable area within the Institute.

In conformity with the original scheme of organisation the Pusa Institute was staffed with an Agriculturist, Chemist, Botanist, etc., and provision was also made for the employment of a supernumerary in each section so that each section was under the control of two Imperial Service officers. Many of these supernumerary posts were subsequently converted into second posts, *i.e.*, Second Imperial Mycologist, etc., and each section was adequately staffed with both gazetted and non-gazetted assistants. Little expansion took place in subsequent years with the result that many of the Provincial Institutes contained a larger staff of workers than the Central

Institute, and in addition, since the advent of devolution, the policy has been followed whenever possible of abolishing the second posts so that in recent years no increase in either the volume or scope of research work has been possible but rather the reverse.

The position may be illustrated by the developments in the Chemical Section. In 1917 when I took over charge there were employed two Imperial Service officers, two gazetted assistants and 6 non-gazetted assistants. With the creation of the post of Physiological Chemist and subsequent transfer to Bangalore, the section lost the service of one gazetted assistant; and the Supernumerary Chemist, whose post is to be abolished when opportunity occurs, has been absent through officiating in other departments. The Physical Chemist has only recently been appointed and the services of one assistant have been permanently placed at his disposal and possibly in the near future another also will be necessary. Allowing for absences due to leave and illness, the effective strength of the staff of the Imperial Agricultural Chemist is reduced to one Imperial Service officer, one Provincial Service officer and four assistants which is barely sufficient to carry out the ordinary analytical work which falls to this section to perform and very little opportunity is available for research work. The position is further complicated by the fact that the present Imperial Agricultural Chemist is also Joint Director of the Institute. When the sanctioned post of Biological Chemist is filled, there will be a further demand thrown on the Imperial Agricultural Chemist's staff. The laboratory accommodation available for the Physical Chemist is totally inadequate and no provision is available for the Biological Chemist. Proposals for the employment of additional gazetted and non-gazetted assistants have been submitted, together with proposals for the provision of laboratory accommodation for the two sanctioned posts referred to above.

QUESTION 4.—ADMINISTRATION.—(a) In the general note covering Questions 1 and 4 attention has been drawn to the fact that with the introduction of the Reforms there has developed a tendency for the several Agricultural Departments in India to become isolated units and that there is little co-ordination of their activities between themselves and the central department. At present the only co-ordinating influences are the personal relation between the various officers and the publications issued by the various Governments. The experts of the central department keep in touch officially with provincial officers through the compilation of annual reports recording the progress of research throughout India and personally through tours taken in connection with their work, but in recent years the opportunity for such tours has lessened mainly through the fact that Provincial Directors are loth to call for their services as this would throw unforeseen charges upon their budgets. The same factor operates in preventing the services of central officers from being utilised for examination purposes, one of the most useful means of maintaining contact. In addition, annual reports are issued giving a detailed account of the research work in progress at Pusa and including a programme of future work.

The influence of the present Board of Agriculture in this direction has also waned in recent years due to the restriction on the number of expert officers attending as members and visitors; to the fact that officers chosen to attend are selected mainly according to the subjects under review; and also that meetings are only held biennially. For similar reasons the sectional meetings of the Board have lost their value and it has become increasingly difficult to obtain a representative attendance sufficient to justify the holding of the conferences.

In view of the above, it must be candidly admitted that there is a break between the activities of the central and provincial departments and also between the latter themselves, which must be bridged if the general agricultural conditions are to be improved, and it has been suggested in the general note that this can best be attained in present circumstances by the scheme outlined therein which would, in addition, permit the Government of India to supplement the operations of the local departments by developing research facilities on a broader basis than at present.

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Apart from this line of development there are other special directions in which the Government of India may usefully supplement the activities of Local Governments:—

(1) Creation of a section of Agricultural Engineering at Pusa with the necessary staff and workshop to investigate the use of agricultural power machinery with special reference to motor ploughs and tractors.

(2) A technological laboratory attached to the Engineering Section for technological investigations arising out of the work of the scientific staff of the Pusa Institute and the provincial departments.

(3) Investigation of sugarcane pests and diseases by appointment of additional officers.

(4) Study of the technique of sugar and *gur* manufacture by the appointment of a Sugar Technologist.

(5) Study of the curing processes of tobacco by appointment of a Tobacco Curing Expert.

(6) Study of the problems relating to crop nutrition by appointment of (*a*) Plant Biological Chemist, and (*b*) Plant Physiologist.

Of these problems, items (1), (2) and (6 (*a*)) have received sanction of the Secretary of State for India but along with other proposals relating to the scheme for reorganisation of the Agricultural Research Institute at Pusa, drawn up by the Government of India in 1921, have not yet been given effect to.

(*b*) It is conceivable that provincial departments would avail themselves of the services of experts on the central staff for the purpose of carrying out special investigations likely to be of a temporary character if such experts were available, but in present circumstances, the staff employed by the Central Government is inadequate for the purpose. A scheme such as the one outlined in the general note would result in the Government of India having under its control a considerable number of officers and it should be possible readily to meet any demands for assistance of a special nature arising from the Provinces.

Recruitment to the central department.—A reference has been made to the difficulties experienced in recent years in regard to recruitment to the central department and, if that department is to expand and at the same time maintain an authoritative position relative to the provincial department, it would appear desirable that future recruitment should be placed on the widest possible basis, so that recruits possessing the widest experience and standing would be attracted. The terms of service should be liberal so as to induce an unrestricted choice and it is suggested that one means of attaining this is to re-introduce recruitment to the Imperial Agricultural Service so far as the central department of agriculture is concerned.

Recruitment, for the proper functioning of the proposed committees, will necessarily require long service recruitment in the majority of cases but it is conceivable that, for investigations of a very specific character which require the services of experienced experts and which are not likely to extend beyond a limited term of years, short-term recruitment must be resorted to.

QUESTION 2.—AGRICULTURAL EDUCATION.—The central department of agriculture does not impart a general education in the theory and practice of agriculture and the allied sciences. Such education is provided by the six Provincial Agricultural Colleges at Poona, Coimbatore, Lyallpur, Nagpur, Cawnpore and Mandalay, the first four of which are affiliated to the local Universities and award a degree in agriculture and the last two give a diploma in agriculture. These colleges cover the greater part of India, but the whole of North-East India, comprising the Provinces of Bihar and Orissa, Bengal and Assam, is unprovided for and consequently these Provinces are not in a position to provide agricultural teaching based on local conditions for the training of students. The existing colleges are as a general rule provided with staffs sufficient to meet existing demands, but the officers also are required in many cases to carry out the work required by the local departments comprising investigation, analysis, advisory functions, propaganda, etc. This leads to the officers having their energies diffused over a very wide field and the Madras Department has, as a consequence, taken the step of separating education from general departmental work by appointing separate staffs. This development leads to increased efficiency by increasing the number of officers available for research and investigation and is one which will have to receive ultimately the careful consideration of all provincial departments.

The position which the Central Institute at Pusa occupies in relation to the provincial activities, is that of a higher teaching institution to enable students, by means of post-graduate courses, to qualify for the higher appointments in the Agricultural Service. At present such courses, which involve training in methods of research and last for 2 years, are given at Pusa in agricultural chemistry, botany, mycology, entomology and agricultural bacteriology.

Only graduates of Indian Universities or agricultural colleges, who are considered fully qualified to take advantage of the courses, are admitted for training, the selection being made by a Board presided over by the Agricultural Adviser to the Government of India.

(*i*) For post-graduate training the supply of teachers and institutions under the Central Government is sufficient to meet the present demand, but if any material increase in this demand develops through the future expansion of the departments, increased facilities will be found necessary. The accommodation in the laboratories is limited and as there are at present no second officers in the various sections the staff would need strengthening.

(*iv*) The main incentive for students to enter the agricultural colleges is the hope of subsequently obtaining entry into Government service. Outside Government service there is practically no prospect of private employment and the landholding class have not shown hitherto any marked tendency to employ agricultural experts in order to help them in the management of their estates.

The attendance at the colleges is as a consequence (and this applies to post-graduate training as well) subject to considerable fluctuation from year to year. When there is a prospect of any department expanding with a concurrent increase in the prospect of service there is a rush of applicants which lessens immediately the demand for recruits is satisfied. The absence of future prospects of employment for post-graduate students at Pusa has reacted in reducing the number and quality of applicants. In present circumstances it is submitted that the most satisfactory means of utilising the facilities for post-graduate training at Pusa would be for the provincial departments to depute approved members of their services.

The normal rate of recruitment to the departments is small and out of proportion to the potentialities available in the colleges and there are in India at present a number of qualified graduates without hope of remunerative employment. In addition there are available a large number of highly qualified graduates of foreign Universities, etc., in the same category.

(*v*) Students are mainly drawn from the educated middle classes and the number representing the actual cultivating classes is small.

(*vi*) No modifications in existing chemistry courses of study at Pusa appear to be necessary at present. The training given is individual in character and can readily be modified to suit requirements.

(*vii*) The majority of students who have gone through these courses are in service in the various Agricultural Departments.

Dr. W. H. Harrison.

ORAL EVIDENCE.

A.2341. *The Chairman:* Dr. Harrison, you are the Imperial Agricultural Chemist and the Joint Director?—Yes.

A.2342. You have given the Commission a note of the evidence that you wish to give. Do you desire at this stage to say anything in amplification of that?—No.

A.2343. Would you give the Commission an account of your own training and past appointments?—After graduating I was appointed Research Chemist to the Leeds Corporation to carry out their experiments on the bacteriological treatment of sewage and subsequently was placed in charge of their works and farms. During that period I gave evidence on three or four occasions before the Royal Commission on Sewage Disposal. At the conclusion of the experiments I accepted a post under the Government of India and was posted to Madras, remaining there till 1917, when I was transferred to Pusa to take up the post of Imperial Agricultural Chemist. In 1921 I was appointed Joint Director in addition to my duties as Imperial Agricultural Chemist and I have been in that position ever since. On three separate occasions I have officiated as Agricultural Adviser to the Government of India.

A.2344. Would you tell the Commission how your responsibilities are divided as between yourself and your colleague?—During the residence of the Agricultural Adviser I deal with the internal economy of the Institute, *i.e.*, with the necessary services such as the supply of water, gas and electricity, and with sanitation and the general upkeep of the Estate, as apart from the Farm. I have to deal with all the financial transactions of the Institute as a whole. During the absence of the Agricultural Adviser I have to deal with certain matters which normally fall to his lot.

A.2345. What matters have you to deal with in the absence of the Agricultural Adviser?—Very often I act as controlling officer and have to deal with questions of travelling allowance and general sanctions. I have also to carry out a certain amount of routine work in regard to publications. I do not, however, deal with the editorial work.

A.2346. Are you responsible for the co-ordination of the work at times when the Agricultural Adviser is absent?—Whenever the necessity arises.

A.2347. How about the suitability or otherwise of the site at Pusa for this Institution?—From my professional point of view I have no objection at all to the site. It is exceedingly suitable for every department of agricultural chemistry and I do not know of a better place. The objection is the isolation of the place.

A.2348. Do you regard the inaccessibility of this place as a serious hindrance?—It prevents people visiting the place who would otherwise do so. It also prevents our getting away easily and for short tours.

A.2349. How about the co-ordination of the work of the various sections at Pusa?—I do not quite understand what is meant by the word co-ordination. In what sense is it used?

A.2350. I will tell you what I mean by the question. I am thinking of work done by several sections in common, *i.e.*, several sections working together on any particular problem?—In other words, the necessity for co-ordination only arises when a problem emerges which requires two or three sections to work on it. In that case the co-ordination is quite satisfactory here.

A.2351. Have you any criticism to make on the internal organisation of this research station?—Personally, none. There is dual control, but personally I have no objections to raise.

A.2352. How about the touch between this station and the Provinces?—It is purely personal, depending on the Heads of Sections very largely.

A.2353. Do you think that it is satisfactory as regards all the major Provinces?—No.

A.2354. Would you amplify that a little?—I think I have made it quite clear in the note I have submitted to the Commission that there is a hiatus now between Province and Province and between each Province and the Government of India. I have nothing to add to what I have already stated in my note.

A.2355. I think you have heard what some other witnesses have had to say about the difficulty of obtaining the necessary sanction for journeys from this place to the Provinces in order to carry out work there? Do you wish to say anything about that?—I know of no instance where a man has been refused permission to tour the Provinces at his own request or where he has not been properly supported.

A.2356. Do you mean refused permission by the Government of India?—No, refused by the Agricultural Adviser as the controlling officer.

A.2357. Is it within the power of the Agricultural Adviser to sanction every journey which he thinks necessary in the interests of the work?—It is within the power of the Agricultural Adviser to withhold sanction to any proposal for a tour and also to withhold the payment of any travelling allowance bill if he is not satisfied that the expenditure has been properly incurred.

A.2358. Do you wish to say anything about post-graduate training in the Institute?—Not in a general sense. I would rather answer specific questions.

A.2359. I have read carefully through your note and I quite appreciate your views. You have made them perfectly plain and there are just one or two questions I should like to ask you. I gather that you are impressed with the success of the Indian Central Cotton Committee and its work?—Yes. I have twice officiated as Chairman of that Committee.

A.2360. The difficulty of arranging some of these organisations lies largely in the difficulty of financing them, does it not?—Exactly.

A.2361. One can conceive a method by which, for instance, jute can be organised and financed. Do you think that it might be possible to arrange for an organisation of the oil-seed interests on similar lines?—I do not think so. It might be possible, but I have not gone into the question of finance. I have carefully formulated a scheme which I think would answer the purpose I have in view. The question of finance I should like to leave to people more acquainted with it.

A.2362. Have you noticed a growing isolation of Pusa since the Reforms were instituted?—Most certainly.

A.2363. Would you agree with me that the opportunities of the staff at Pusa to have their recommendations listened to rest at this moment almost entirely on their individual reputation?—Purely and simply on their personal relations with the Provinces and their reputation with the scientific officers there.

A.2364. What have you to say as to the prestige that Pusa enjoys at this moment? Do you think it stands high in the Provinces or not?—I think it does. Of course, it is only natural that they should prefer to run their own show without outside interference, and having served in a Province myself I quite appreciate that point of view. They are afraid, I think, of accepting domination from any outside body.

A.2365. It is the case, is it not, that vacancies at Pusa do not attract officers in the Provinces in the way one would hope they would?—In later years it has been impossible to recruit from the Imperial Service in the Provinces to Pusa. The prospects at Pusa in the early years were quite distinctly better than in the Provinces and we could recruit then, but in later years, particularly with the changed scale of emoluments, the prospects in the Provinces are brighter than they are at Pusa.

A.2366. Do you think that it will be possible in the future to maintain the prestige, the reputation and the usefulness of Pusa if the posts at Pusa are less attractive than those in the Provinces?—No. My object in formulating the scheme I put before you was to create a number of attractive posts which would attract to the Central Service the best men possible.

Dr. W. H. Harrison.

A.2367. *Sir Henry Lawrence:* You referred to some change in the system of pay; what change were you referring to?—It was the introduction of the selection grade posts in the Provinces. Previous to that, there was one grade of pay throughout the Service, and the officers deputed to Pusa, and who served under the Central Government as Heads of Sections got a separate personal allowance. With the introduction of the new scale of pay, which runs, I believe, to Rs, 1,250 normally, the Pusa allowances were increased in proportion. But in addition to the maximum of Rs. 1,250, selection grade posts were introduced running from Rs. 1,500 to Rs. 1,750, so that the position of the Head of a Section at Pusa became only equivalent to the position of an officer serving in a Province in the selection grade and also as Principal of a college. In addition to that, it was laid down that selection grade posts should not be given until a man had served 15 years, but exceptions were made, and men have been promoted to the selection grade in Provinces at a much earlier date. Consequently, the hope of promotion to higher pay is greater in the Provinces than at Pusa.

A.2368. You do not suggest that the immediate prospects in the Provinces are excessive?—Over and above that, owing to the action of the Reforms in introducing retirement on proportionate pension, many of the senior men in some Provinces have retired, and in those Provinces men comparatively junior have received early promotion.

A.2369. Was any attempt made to equalise the position of the men here to the former comparatively higher standard? Was any proposal put up to the Government of India and turned down? Previously, the staff at Pusa were comparatively rather better off than the staff in the Provinces. When the staff in the Provinces had their prospects and pay improved, was any proposal sent up from Pusa to have a similar improvement made here?—Not to my knowledge.

A.2370. There has been no disinclination on the part of the Government of India to give any improvement here?—I am only speaking from my own knowledge. So far as I am aware, the question has not been put to them in the form in which you have put it, but when these scales of pay were revised, the Directors of Agriculture were permitted to draw extra pension on the lower scale on the Lee grade, but the Heads of Sections at Pusa were not included in that category. Representations were made to the Secretary of State, and now the Heads of Sections are included in the same category and draw extra pension on the lower grade. That is the only representation with which I am acquainted.

A.2371. *Sir James MacKenna:* The rates of pay fixed by the Lee Commission were introduced both in the Provinces and at Pusa?—Yes.

A.2372. *Sir Henry Lawrence:* There has been no representation made by the individuals affected here?—Not within my knowledge.

A.2373. What is the system in force here, governing the correspondence between Heads of Sections and local officers in Provinces?—They are permitted to correspond direct on all questions which do not deal with administrative affairs.

A.2374. What do you mean by administrative affairs?—They have a free hand to correspond with regard to their own work, but not with regard to anything which may affect the administration.

A.2375. Administration of what? Of their own section?—General administrative matters referring to the Agricultural Department as a whole. I rather think that the point was raised in the very early days, certainly outside my own personal knowledge, by some Madras officer. I think it was raised by the Madras Government, in the first instance. It was proposed (I am only speaking from recollection) that officers in Madras should be allowed to correspond direct with the Imperial officers, and this was agreed to, subject to the reservation that they must confine their correspondence to professional matters; otherwise, it must be carried on through the Head of the department.

A.2376. And, in your opinion, there has been no inconvenience and no restriction on useful work by the officers at Pusa being debarred from corresponding with provincial officers?—There is no restriction on an officer at Pusa corresponding with any of the officers in the Provinces on professional matters.

A.2377. If he is asked to go and investigate a local problem, he can go away on his own discretion?—It depends on how he places it before the authorities.

A.2378. On his own discretion?—No, he cannot go on his own discretion. Every officer here has to get sanction to go on tour from the Director; previous sanction is necessary.

A.2379. The Director may be in some other part of India?—There are two of us; when the Agricultural Adviser is away, the discretion lies with me as Joint Director.

A.2380. So that there is no necessity for any correspondence. He can come to you and say that there is an urgent problem awaiting investigation somewhere and he wants to tackle it?—He will get sanction.

A.2381. Does he take the sanction in advance or afterwards?—In advance. The justification is merely his statement that there is an important problem; he is the expert concerned, and his word is taken. But if he were to put up the proposal on the ground that the Director of Agriculture of that Province has asked him to go there, I am afraid we should come under the operation of the Devolution Rules.

A.2382. Can you mention the Devolution Rule in question?—I cannot mention any specific one; I can only refer to the general trend of the orders issued by the Government of India regarding the conduct of affairs.

A.2383. Could you put up the Government of India orders on the subject?—I think so; I cannot do it now.

A.2384. Will you send them up?—Yes. There are several points on which the Government of India have laid it down definitely and distinctly that the Central revenues are not to be expended on matters which fall within the legitimate sphere of work of a Province.

A.2385. Will you make a *précis* of those orders and send us copies of the actual wording of the orders from the Government of India on this point?—To the best of my ability, I shall do so; I will let you have whatever I can put my hands on.

A.2386. *Sir Ganga Ram:* You are the Imperial Agricultural Chemist; are you the Soil Physicist also?—No; there has been a new officer recruited to that post.

A.2387. There was going to be a new appointment?—There is one.

A.2388. Who is it?—Dr. Puri.

A.2389. On page 268, you advocate the creation of a new department here. You say, " Creation of a section of Agricultural Engineering at Pusa with the necessary staff and workshop to investigate the use of agricultural power machinery with special reference to motor ploughs and tractors." What about pumping? Do you not attach any importance to it?—I have no objection to pumping being included in it.

A.2390. If that department were created, would any of you be able to undertake it, or would you require another engineer to do it?—We should require special recruitment for it, a special officer.

A.2391. At present, do you teach your students questions relating to water?—I am not an agricultural engineer.

A.2392. In what do you help them? How far do your duties go?—I am not an engineer; I do not deal with engineering matters at all.

A.2393. You want to create an engineering section?—Yes.

A.2394. Do you teach the students in this institution enough to enable them to say how much land can be irrigated by a given quantity of water?—Are you referring to me personally, or to the Institute?

A.2395. You may call it both?—No, I cannot answer that.

A.2396. But you raise the question of creating an engineering section here and you refer to agricultural engineering?—You asked me if I did it; I do not. So far as the Institute is concerned, the Agriculturist deals with that matter. We have a pumping plant on the estate, and to that extent the students even now become acquainted with a certain amount of irrigation.

A.2397. Can they say what power is required to pump up a given quantity of water?—I cannot answer that question.

A.2398. *Sir Thomas Middleton.* You were the Imperial Agricultural Chemist here until 1921, and then you became Joint Director?—I am still the Chemist.

A.2399. I appreciate the fact that you are still the Chemist; it leads up to my next question. To what extent do you find the duties of Joint Director interfere with your technical work in Chemistry?—Very seriously. My duties as Joint Director on the average occupy me for 2 to 3 hours a day, and towards the end of the financial year probably the whole day. I should say, generally speaking, that I have only, at the most, about 3 hours a day to dispose of work outside the central office, of which I give as much as I can to my own section.

A.2400. Was any addition made to the staff of the department when they created the post of Joint Director?—No; I have been singlehanded.

A.2401. You yourself find no difficulties have arisen because of dual control and the fact that there are two Joint Directors?—No, it is purely a personal matter; our relations have been good, and so long as they are good, there is no difficulty whatever.

A.2402. But you recognise that a position like this is one which might very readily lend itself to difficulties?—I can quite appreciate that point.

A.2403. In your own experience, has there been any indication of it?—I can see many pitfalls.

A.2404. You have pointed in your evidence to the waning influence of Pusa in connection with the provincial departments, and you have indicated very clearly how that position has arisen. I think you will agree that any section of Pusa should be in a much stronger position than the corresponding section in any particular Province; that would be the ideal position?—In regard to staff?

A.2405. In regard to staff. We must take it first in terms of staff and ultimately in terms of prestige?—No; I think the real point is that the sections at Pusa should be free from interference through routine duty; the routine duties usually fall to the provincial staff; the Pusa staff should be free to carry out research work. They should be free to carry out their duties, duties which fall to each section as forming part of the central bureau of the Government of India. They should also be free to give full attention to a few carefully selected post-graduate students; but they should not be mixed up with the detailed duties which fall to the lot of the provincial departments.

A.2406. I was thinking of the difficulties you indicated, the lack of financial attraction offered by Pusa at present to provincial officers and of the effect of that in future on the quality of the officers who will be attracted here?—I think there is a factor which has been referred to and which is probably more important than the financial attraction, namely the fact that officers in the Provinces can retire now on proportionate pension, while officers serving directly under the Government of India are not allowed to do so. Officers are not going to sacrifice that privilege and take up a post under the Government of India.

A.2407. Will not that state of affairs be temporary?—Yes; I believe it ceases in 1929.

A.2408. So that after 1929 the former position of the posts at Pusa in relation to provincial posts will be re-established?—Except from the point of view of financial equality.

A.2409. Are the facilities offered by Pusa at present being fully utilised? By that I mean, could you without further capital expenditure accommodate a considerably larger staff in any of your sections?—No. Considerable financial expenditure will be required if that is to be done, not merely in providing larger laboratory accommodation but in providing greater residential accommodation.

A.2410. Are the existing benches in all the laboratories occupied at present? —I know they are in mine. I cannot answer for all.

A.2411. You point out in another connection the value that has attached to the meetings of the Board of Agriculture in the past and the fact that these meetings are less frequent than before. Is the cost of a meeting heavy? Has that been worked out in connection with the meetings at Pusa?—Not the total cost. That includes the cost of the travelling allowance for all the officers attending. That has never been worked out.

A.2412. From the information at your disposal could you give a rough estimate of the cost of holding a meeting?—I could make a rough estimate. If you require one from me I can work out one.

A.2413. *Mr. Calvert:* Half a lakh of rupees?—Probably.

A.2414. *Sir Thomas Middleton:* You have had long teaching experience in Madras?—Yes; I originated the chemistry courses there.

A.2415. Have you formed any impression as to the supply of students in the superior agricultural colleges in India? Have you now got a sufficient number of colleges in India to meet the requirements?—There is a college in most of the major Provinces except in the eastern part of India, by which I mean Bihar and Orissa, Bengal and Assam; there is no college in that area.

A.2416. You have not heard of any strong demand arising for a college in any particular area?—No. I think there is such a demand now in the Telugu districts of Madras.

A.2417. With regard to the training of men in your own subject, chemistry, what type of training would you desire in the assistants you recruit for your research work?—I demand a good general knowledge of chemistry with a fair knowledge of the technique of practical chemistry and also I demand a good character. I think these are the first essentials.

A.2418. I think Indian Universities are devoting a very considerable amount of attention to chemistry. Have you found that the quality of your assistants in different parts of India has been satisfactory?—I have not had the privilege of recruiting a single assistant in my section since I came to Pusa except by transference from the Indigo Section, which was abolished.

A.2419. Previously in Madras?—I had no difficulty in Madras.

A.2420. You were successful in getting some very good assistants?—I would refer to Mr. Visvanath, at present the Government Agricultural Chemist in Madras, who compares very favourably even with those of European standards.

A.2421. *Dr. Hyder:* What are these concessions made by the Lee Commission to which you refer in your note of evidence? What concessions are you referring to which you say are given to the provincial agricultural officers?—The concession to retire on proportionate pension and also the concession of a selection grade.

A.2422. Taking the matter of retiring on proportionate pension, you are aware that the position of an officer in the Central Service in the field of agriculture is the same as it was before the introduction of the Reforms; is that not so?—It is stated so on paper. I cannot altogether accept it. It is not the same; we are affected indirectly by the operation of the Reforms throughout India.

A.2423. But constitutionally your position as stated clearly by the Lee Commission *vis a vis* the Assembly remains where it was?—Constitutionally it remains the same. I can accept that.

A.2424. And that concession to the officers operating in the Provinces on the introduction of the Reforms was given on the ground that they might not like to serve under Ministers?—That is quite true.

A.2425. But no change has taken place as regards the position or the careers of men who are still in the Central Service?—None at all. That was not my point. My point was that the recruitment of officers serving in the provincial departments to the central department has been affected.

A.2426. You know many of these officers took advantage of the concession?—Yes; a large number.

A.2427. Then you complain further on in your note of evidence that Pusa has had the misfortune to be staffed by comparatively junior men?—That is in the last few years. We tried to obtain senior, experienced men for two posts here and we could not recruit them.

A.2428. But these senior, experienced men to whom you are referring are men who are engaged in administration and not in research which is primarily the function of this institution?—No; I am referring to officers engaged actively in research in the Provinces whom we wished to recruit to Pusa. I am also referring to the case of persons who have specialised training whom we could not recruit here because in that case the Government of India would not sanction the post for a period of more than five years; it was a temporary post.

A.2429. *The Raja of Parlakimedi:* What experiments do you do to study the requirements of the soil?—I have not taken up that enquiry particularly here.

A.2430. As regards the supplementing of nitrogen on the soil what crops do you suggest should be grown?—Leguminous crops.

A.2431. What is the best crop for that purpose?—I am not an agriculturist. I have not made a specific study of that subject.

A.2432. While you were at Coimbatore did you consider what the best rotation crop would be after paddy?—I did not, because all the paddy lands I was acquainted with and worked on were simply paddy lands, except in the Kistna, where *sann*-hemp was grown as a casual crop towards the end of the paddy season.

A.2433. Do you not think the growing of green gram as a rotation would serve the purpose better for paddy?—I am speaking of my experience of 10 or more years ago, and I can only speak with regard to irrigated paddy, that is, paddy in land which is kept under several inches of water throughout the whole period. In that case I do not think it is advisable to grow a second crop. I do not think, from my recollection of Madras, that under those circumstances it is advisable to go in for a second crop.

A.2434. How about leaving it fallow for one year?—I do not think you can gain anything by that. Paddy is a crop that seems to make a very small demand on the soil; it is a crop which is very easily cultivated, and I do not think you would gain anything by allowing ordinary paddy land to lie fallow. If there is salinity or other defects you might allow it to remain fallow.

A.2435. Conditions in Italy are I believe so different from those in India that in Italy they very frequently have a rotation of paddy and fallow?—Quite so, and the conditions of paddy cultivation vary throughout India from one Province to another so that it is very difficult to lay down hard and fast rules on points of that nature.

A.2436. There is nobody here to tackle the point so far as this part of the world is concerned, is there?—We cannot do it here because we have no paddy land on the Institute; but paddy cultivation is under review by the Bihar and Orissa department.

A.2437. Do you know whether anything is being done there?—They have paddy farms, they are selecting seed grain, and they have manurial experiments going on.

A.2438. For merely experimental purposes it is not very difficult to prepare land for growing paddy, is it?—No, but at present the bulk of the farm is required to feed the herd of cattle here; and even if we could convert part of the farm into paddy land, that fact would probably operate against introducing paddy cultivation here under present circumstances.

A.2439. *Sir James MacKenna:* Have the duties of the Joint Director increased materially in recent years?—Every year sees an increase.

A.2440. You have held that post off and on since 1921, I think?—Yes, for 5 years.

A.2441. When the post of Joint Director is held by the Head of an important section, do you think it materially affects the amount of time he can devote to his scientific work?—In my own instance it has seriously affected the amount of time I can personally devote to research in my section. For that reason my work now is to sketch out roughly the problem, and when I feel on fairly safe ground, to turn it over to an Assistant to work out in detail, under my guidance, of course.

A.2442. Would you recommend the revival of the post of Assistant to the Agricultural Adviser, or what other method would you suggest to meet this difficulty of the loss of scientific research which accrues from the Head of a Section having to discharge the onerous duties of Director?—Personally I think the solution lies in separating the post of Agricultural Adviser from that of Director.

A.2443. You would have a separate Director for Pusa?—Yes.

A.2444. Would his duties be those which are now discharged by the Joint Director, or would he take over some of the duties which now fall upon the Agricultural Adviser?—The bulk of them are those which now fall to the Joint Director, but he would have more time to attend to the details than the Joint Director has now.

A.2445. For instance, would he be President of the Pusa Council?—Yes.

A.2446. And would act as the co-ordinating officer of the scientific branches of the Institute?—Yes.

A.2447. What has been the recruitment of agricultural chemists to the Imperial Service during the last 10 years? Could you give me a rough figure? —There have been three recruitments of European officers, one of whom has since resigned; one to Bengal, one to the Punjab, and one to Burma. Promotion from the Provincial Services has occurred in Madras, Bombay and the United Provinces.

A.2448. That is six vacancies in 10 years?—Yes.

A.2449. Do you anticipate that the vacancies in the ensuing 10 years will be less or more?—If the scheme I submitted is acceptable, I anticipate there will be quite a number of vacancies in the near future, not only of chemists but of other scientific officers.

A.2450. With reference to the Indianisation of the Service, which you know is an accepted principle of Government, do you think the post-graduate courses here should be limited to men selected or nominated for appointment, or should be extended to private students who want to work on a special branch of chemistry?—In view of the few posts which are available, I think it ought to be limited to nominations by the Provincial Governments or by the Government of India; I think it is unfair to turn out a number of highly trained men who can find no resting place within India.

A.2451. So that, accepting that policy, the present rate of recruitment to the post-graduate courses in chemistry at Pusa are in your opinion adequate; it contemplates four?—It contemplates four, but actually I have only had three, of whom one resigned after a month's trial, and none have been recruited during the last year.

A.2452. So that you do not think the idea of post-graduate training at Pusa requires any more emphasis than has already been given to it?—Not until the necessity arises.

A.2453. I suppose you would welcome an officer who desired to work on a special piece of research here, if you could find laboratory accommodation?—

Yes, provided it was agricultural research; I should not welcome an officer coming here to do general research.

A.2454. Do you think the Universities could be approached to recognise research work done here for the higher degrees of the Universities, such as the D. Sc.; do you think it is worth taking that question up?—That would mean a demand for students to come to Pusa merely to work for a degree in a University; I am not in favour of that.

A.2455. Supposing an M. Sc. wanted to go on to a D. Sc. degree and for that purpose proposed to undertake a problem with reference to agricultural chemistry, soil physics, or something of that kind, do you not think it would be an advantage to the Institute if you could find room for such a man to do his research?—If he applied for admission in the ordinary way and he understood quite clearly that there was no hope of gaining a post in Government service, he would probably be accepted.

A.2456. Yes, I mean that. It would perhaps help the Institute if you had one on two of that kind of men coming forward?—Yes; but as it is nobody applies unless he wants a Government post; that is the sole aim.

A.2457. *Professor Gangulee:* Have you visited any well-known European research institute?—Yes, I have seen two or three.

A.2458. In England?—Yes.

A.2459. And in Europe?—No, I have not been outside England; as a matter of fact, I was 15 years in India without getting home except for 3 months, so that I have not had much opportunity of visiting places abroad.

A.2460. How would Pusa Institute compare with the Institutes you have visited?—Very favourably I think.

A.2461. In matters of equipment, staff, accommodation and so on?—Yes.

A.2462. What are the fundamental conditions do you think that would go to establish the reputation of a research institute?—Your question is too general to answer.

A.2463. Just answer generally?—I cannot answer generally a question of that type; it would take a book to answer.

A.2464. You can enumerate the chief conditions?—I am afraid I cannot.

A.2465. Would you say that you have succeeded in developing the scientific spirit and atmosphere here?—I think so.

A.2466. Could you tell us exactly the function of the Pusa Council?—The function of the Pusa Council is to consider proposals for research put forward, to deal with publications put before it and to decide whether they are fit for publication or not; it acts as an editing body. Its functions practically end there unless requested specifically by the Director to deal with any specific point.

A.2467. *Sir James MacKenna:* Is not there a set of rules for the Pusa Council laid down by the Government of India?—Yes.

A.2468. Could you submit a copy to the Secretaries?—I will supply a copy.

A.2469. *Professor Gangulee:* Sir Thomas Middleton made a reference to your administrative duties; do you consider that your administrative duties as Joint Director act as a handicap to your own research work?—To my personal research work yes, but not to the initiation of research work.

A.2470. I am referring to your own work?—They certainly have; if you take 3 hours off a man's day, you lose so much research work.

A.2471. But you have time to supervise the work of your Assistants?—Yes, but I may point out that during the last three years I have only been in charge of my own section for about 9 months.

A.2472. Could you tell the Commission the nature of the work in which your Assistants have been engaged? Are they doing routine duties?—The laboratory must carry out the analytical work demanded by the other sections; that is its primary duty; that is necessary if the work of the Institute is to be carried on effectively. After that the whole of the time is available for research work.

A.2473. And in your opinion your Assistants do have sufficient time for their own research work?—I think the volume of work put out by my Assistants shows they have the time. I will admit that at certain times of the year their research work has to drop until the routine work has been passed through.

A.2474. Do these Assistants work chiefly on problems suggested by you or on problems that they themselves want to tackle?—I encourage any Assistant to put forward any suggestions for research, and if I am satisfied of the feasibility of them, I am prepared to give any assistance within my power.

A.2475. Therefore these young research workers do receive the required encouragement from the departments?—So far as I am concerned they do, and, what is more, in later years I have made a practice of not permitting my name to appear on the publications; they are published under the name of the Assistant who is responsible for the main work.

A.2476. Do you occasionally discuss with your Assistants the drift and nature of the problems?—When they have got their results to a point at which they feel they can discuss them with me, they are perfectly at liberty to approach me at any moment on the subject.

A.2477. Turning to the general agricultural question, has there been a systematic survey of the nature of the problems that require to be tackled relating to agricultural chemistry and bio-chemistry?—No, I think that depends on what arises in the Provinces; it depends on the activities of the provincial departments mainly; the conditions and the problems vary from Province to Province.

A.2478. But I am referring to the fundamental questions?—I do not understand what you mean by fundamental questions.

A.2479. For instance, the movement of soil nitrates is a fundamental question?—That is only feasible in a station like Pusa where we have a soil of unlimited depth; you could not carry on an investigation like that in a station like Coimbatore where you have a rock subsoil.

A.2480. I follow that, but I wanted to know the number of problems like that of the movement of nitrates which you can suggest should be dealt with by the Imperial Institute?—I cannot do it orally; I am prepared to give a statement to the Commission if they require it.

A.2481. I want to get, if I may, from you, a systematic survey of the agricultural chemical problems that could be undertaken in a central institution of this kind, without taking into consideration what might be done by the Provinces?—No such survey has been made; it has been left to the initiative of the Head of the Section.

A.2482. Is there any continuity of research? When you undertake a problem, do you see it through?—Yes, to the point of either discarding it, or publishing one's ideas.

A.2483. Coming to a positive or negative conclusion?—Yes.

A.2484. May I refer you to Dr. Leather's work on the water requirements of crops, which is to my mind very important. Has that work been followed up?—Not since I took charge.

A.2485. So that that work stopped where Dr. Leather left it?—Exactly.

A.2486. You attach a great deal of importance to that problem?—I do, but it is not a subject which attracts my attention.

A.2487. You have now a Soil Physicist in the department. What particular problems are being undertaken by the Soil Physicist?—That officer is a fully trained officer. He does his own work independently. Apart from the administration of the section and excluding the matter of finance, he is an independent officer.

A.2488. Is it your observation that there is a serious phosphatic depletion in the Indian soil?—I have heard that put forward in many places, particularly with these calcareous soils. I do not consider that the methods of analysis are sufficient to show definitely that there is a depletion.

A.2489. Do you consider that Dyer's method would not give you exact data?—Certainly not.

A.2490. We were told in the Madras Presidency that there is a serious phosphatic depletion?—Yes, I know that myself. I can point to places where there is a serious deficiency.

A.2491. We were told the same in Bengal?—Quite probably.

A.2492. You stated a moment ago that Dyer's method of the determination of phosphorus was not satisfactory. Have you developed a method of analysis?—We have examined the method of alkaline extraction which we find very effective in regard to the calcareous soils and with the help of the provincial departments I have been able to get standardised soils of crops and manurial history and these are now being examined.

A.2493. Then do you agree that if you could develop methods with calcareous soils, it would greatly facilitate the work not only of the Institute but also of all chemists?—Possibly. But I am not very much in favour of standardisation; though, for ordinary analytical work, standardisation is probably necessary. The danger is that it may stereotype research. I am not in favour of it unless it is necessary.

A.2494. I was particularly referring to the analytical method. Now, with regard to post-graduate training you have already stated your views. Do you not think that this Institute could be developed into an Imperial Research Institute and College, considering that it has all the equipment necessary and an excellent farm and an efficient body of scientific workers?—No, the scheme I outlined would continue the research facilities which are open now but would really make Pusa a central bureau for the central department and would lead to the institution of a number of experimental stations throughout India, each devoted to a specific object.

A.2495. Would you approve of the idea of the affiliation of this Institute to a University?—Certainly not.

A.2496. If you would look at the map of Asia you will find that there are only two Imperial Institutes, one serving China, Formosa, the Phillipine Islands and Tokyo. I think that if you could develop Pusa into an Imperial College of Research it would serve India, Burma, the Straits Settlements, Siam, Ceylon, some part of Soudan, Kenya, Mauritius and Iraq?—I cannot conceive of Government entertaining a scheme of those dimensions.

A.2497. You could not envisage a time when this Institution could be developed to that status?—Not at the expense of the Government of India.

A.2498. On page 262 you make a statement that the central department can no longer exercise the same influence over the development of the Provinces as hitherto and you ascribe this tendency, I take it, to the Reforms. Am I right in thinking that things were much better before the Reforms?—They were much better in the earlier days, undoubtedly, but, as I pointed out, that was partly due to the fact that when we were recruited to the department we came in as inexperienced officers and we were only too glad to avail ourselves of the experience of the senior men at Pusa. As time went on we were dealing with our own local problems in the Provinces and we were quite capable of tackling them, so that references to Pusa gradually became less and less. At the same time, when intricate points arose which we were not able to tackle, we referred the matter to Pusa and got what we wanted. And personally, I got considerable help from Dr. Leather.

A.2499. Would you agree with me that the influence which you are referring to depends more on the scientific reputation that you are able to create and the prestige that you are able to have for the Institute?—All reputations more or less depend upon that.

A.2500. I am sorry if I have not made myself clear. The political situation created by the Devolution Rules under the Government of India Act should in no way interfere with that influence which depends on scientific reputation?—It is simply drawing the Provinces into isolated departments under a Minister. They become separate entities and there is no organisation extant to bridge the gaps. I do not say that it is impossible to suggest a means of bridging them.

A.2501. Do you agree with me that there is scientific co-ordination between England and Germany, although these two countries are separate units politically?—I do not understand what you mean by scientific co-ordination. There is no compulsory co-ordination between the science of England and Germany; it is purely voluntary.

A.2502. But they do come in contact when they are faced with scientific problems?—That is what I meant when I said voluntary co-ordination.

A.2503. So you agree that co-ordination and co-operation are possible in India in spite of any political adjustments?—The whole of my scheme is designed from that point of view, to obtain voluntary co-operation and co-ordination.

A.2504. And you consider the line of cleavage produced by these political circumstances may be obliterated by the scheme that you have presented to us?—That is my opinion.

A.2505. Turning to another subject, would you kindly tell us the functions of the Board of Agriculture as they exist now?—They are purely advisory, as a matter of fact. The Board meets with the object of discussing outstanding problems relating to Indian agriculture and to pass resolutions for the acceptance of the authorities.

A.2506. We have been told by one of the witnesses that the proceedings are rather dull? Do you subscribe to that view?—Yes, I certainly think so. Latterly the whole business has been dominated by the subject of cattle, and that did not interest me.

A.2507. Are any scientific problems introduced at that Board?—Very few.

A.2508. Do you approve of the idea of sectional conferences?—We have had, I think, three chemical conferences, but they have been discontinued.

A.2509. Why were they discontinued?—Because we could not get a representative body of chemists together.

A.2510. I saw a number of sugar-beets in your laboratory. What possibilities are there for the introduction of sugar-beet in India?—I believe the prospects are very good in the North-West Frontier Province. In regard to Bihar the prospects depend on irrigation facilities and the attractiveness of the crop.

A.2511. And the percentage of the sucrose content is certainly a deciding factor in many cases?—The sugar-beets we grow here when matured are quite as good in quality as those grown in Europe; only we have to grow them under irrigation.

A.2512. So you consider that sugar-beet could be introduced in this country in irrigated areas?—I would not put it in that way. I would rather say that it could be grown provided it was an economic crop. But I do not know whether it is an economic crop.

A.2513. *Mr. Kamat:* I have read your general note with considerable interest; I should however like to clear up one or two points about your scheme. I note that you have taken a perspective of the present situation with considerable fairness and accuracy but I want you to contrast your scheme with another scheme which we have before us, namely Dr. Clouston's scheme of co-ordination. You realise that after the Reforms the Provinces have become independent units in the matter of agriculture?—Yes.

A.2514. You also realise that owing to the Lee Commission's recommendations and the principle of Indianisation certain changes will take place which you cannot unsettle?—Yes.

A.2515. And that instead of trying to unsettle the settled facts we must find a solution for co-ordination between Provinces and between the Central Government?—Yes.

A.2516. You find that the germ of the whole situation lies in creating committees something like the Indian Central Cotton Committee for the purpose of co-ordination and research work?—Yes, the creation of an atmosphere of voluntary association.

A.2517. And you also emphasise that any co-ordination between the Central Government and Provinces must be on the basis of a purely voluntary spirit?—Certainly.

A.2518. It would be left to the Ministers to ask for assistance if they cared to ask for it and not for any advice or interference to be forced on them?—I certainly have no intention of forcing anything on them.

A.2519. Now about your scheme. Based on these considerations you proceed to say, if I understand you aright, that at the apex, attached to the Executive Councillor with the Government of India in charge of Lands, there should be a sort of Advisory Council. Is that right?—Yes.

A.2520. That this Council should be composed of 4 or 5 experts, whom you call the first member, the second member and so on?—Yes.

A.2521. And they should advise the Executive Councillor on questions like animal husbandry, crop protection and so on?—Yes.

A.2522. Where do the All-India Crop Committees come in?—You have rather begun my scheme from the wrong end. I would rather begin from the Provinces and go upwards, than from the Government of India and come downwards.

A.2523. You can begin from the bottom, if you like?—It should be just as you have in the case of the Cotton Committee. There you have a number of interests which operate throughout India; they are not confined to any one particular Province. You may even include co-operation, agricultural economics, some of the major crops, and you may even include subjects like general propaganda, and crop protection regarding the whole of India.

A.2524. I am not concerned with the number of subjects on which you want central committees; I want to know their place in the gradation and their powers as regards finance?—I do not wish to be asked any questions regarding finance in my proposals, as I cannot answer them. I have simply put forward a scheme for the formation of committees, each dealing with a fairly clearly defined field, each being supplied with funds, and each operating over the field which is defined.

A.2525. I follow that; probably I have not made my difficulty clear to you. I know the functions which you assign to these All-India crops committees, for instance, on wheat, or sugarcane, or anything else. What is the relation between these committees and the Advisory Council which you propose should be attached to the Executive Councillor with the Government of India?—Just as in the case of the Cotton Committee, you will have a number of committees each dealing with a multitude of factors. The Indian Cotton Committee does not deal with just the raising of cotton; it deals with marketing and selling and many other factors; even the economics of the cotton trade comes within its purview. So, you have a number of committees throughout India, each dealing with a multitude of subjects. Those have got to be correlated before they are of any use to the Government of India, and the function of the Board which I suggested is to do that. If you have a member dealing with economics, he will have to be in contact with the appropriate central committee or committees.

A.2526. Are the members whom you propose should be attached to the Advisory Council of the Executive Councillor that you propose to be drawn necessarily from these All-India committees, or are they to be men of general expert agricultural knowledge, independent of them? And how are the funds to be allocated to the various committees?—The members need not necessarily be drawn from the committees. As regards funds, there being control of the committees, funds would find their way down to those committees through them.

A.2527. These committees have not to sit at Delhi?—If every committee concentrates at Delhi, the result will be too large to be of any practical utility to anybody.

Dr. W. H. Harrison.

A.2528. Secondly, I should like to ask you, when you propose that the Executive Councillor should have attached to him a Council of 5 or 6 members, are they all necessarily to be officials?—No.

A.2529. Are they to be officials and non-officials?—It was not my intention that they should be officials altogether, but it was my intention that where a member had to deal with a subject requiring expert knowledge, he should be an expert in that subject.

A.2530. Taking a concrete case, therefore, Sir Muhammad Habibullah should have half a dozen non-officials attached to him to advise him on agriculture?—Not non-officials.

A.2531. Either necessarily officials or non-officials?—Yes, according to their selection.

A.2532. According to their knowledge and capability?—Yes.

A.2533. And these 6 members ought to be in a position to tender advice from the fact of their being in touch with these all-India committees on wheat, rice, paddy and other things?—Yes.

A.2534. As against your scheme, let us have Dr. Clouston's scheme, in which it is proposed to have one Central Advisory Board composed of a fairly large number of people representing the research officers at Pusa and representing territorially the Provinces also. In that scheme there is no intermediate step, such as you propose, of having 5 or 6 members in charge of animal husbandry or other subjects, who might tender advice to the Executive Councillor. Which scheme do you like better? Naturally, of course, you would like your own scheme. But have you considered Dr. Clouston's scheme, in which there is no intermediate step?—I have considered it; it is not merely a question of opinion. I am not in favour of a large body constituted in the way suggested. I cannot conceive of the Government of India devolving its administrative functions to a body of that type, susceptible to outside influences.

A.2535. In other words, you think a Central Advisory Board, called from all parts of the country throughout India, would be an unwieldy body, and not likely to advise the Executive Councillor on technical questions?—I simply look upon it as an unwieldy body for the purpose of carrying out the mechanism of the department.

A.2536. You think the mechanism or machinery would not work satisfactorily?—In my opinion it would not.

A.2537. Under your scheme, would you abolish the present Board of Agriculture entirely?—Yes.

A.2538. You think it is now an effete body, which has served its purpose?—I do not call it effete, but I think if the scheme I have propounded is accepted, there is no further need for it; the committees would take its place, and they would be far more effective than the Board of Agriculture we now have.

A.2539. Are these 5 or 6 members which you propose to attach to the Executive Member in charge of lands to be salaried men or honorary people?—Salaried, certainly. It would be a working Board.

A.2540. A working body permanently attached at the headquarters of the Government of India?—I presume so; I did not consider the point of attachment.

A.2541. *Sir Ganga Ram:* What do the post-graduate students learn in your line? I suppose they have done all the book work before they come here? Do you teach them the practical application of chemistry to agriculture?—Yes. When they come to me, I find that they have a fair amount of general book knowledge, but they are very weak in technique, that is in quantitative analysis and manipulation and I have to spend a certain amount of time teaching them laboratory methods. After that, I try to get them on to research work as soon as possible, research connected with some problem in agriculture, my endeavour being to make them, if possible, persons capable of carrying out research on their own account.

A.2542. Capable of becoming agriculturists themselves or simply for employment in the Agricultural Service?—If you mean as farmers, I do not train them as farmers, but I train them as research chemists.

A.2543. Are you teaching them any practical applications of chemistry to agriculture?—I am not teaching them farming at all; they come to learn agricultural chemistry, and I teach them agricultural chemistry.

A.2544. You have stated that something will transform itself in 1929; that is the year in which our politicians expect full self-government?—Personally, I am not very much interested, because I retire 2 years afterwards.

A.2545. I can read between the lines of your reply couched in cautious language, but tell me frankly, has the introduction of the Reforms furthered the cause of agriculture?—I prefer not to answer that question.

(The witness withdrew.)

Mr. J. H. WALTON, M.A., M.Sc., Imperial Agricultural Bacteriologist, Pusa.

Replies to the Questionnaire.

QUESTION 1.—RESEARCH.—(*a*) For the better organisation and administration of research, I would recommend the formation of an Advisory Council, consisting of representatives of the Central and Provincial Governments. This council would have the assistance of expert committees for the consideration and preparation of programmes of investigations on definite problems in connection with such subjects are cattle-breeding, fertilisers, crop improvement, dairying, etc. The composition of each committee would naturally depend on the subject of investigation and the localities in which it was proposed that work should be carried out.

The Advisory Council would need to be provided with funds for subsidising approved investigations, the programmes and estimated costs of which had been presented to it by the committees, and the work would be carried out, according to circumstances, by provincial departments or by the central department, alone or in collaboration.

The funds needed by the Advisory Council would have to be provided from central revenues, for the work carried out would be additional to that already being carried on and financed by the Central Government and by the Provinces. Such a scheme will have its full value only if all the provincial departments are willing to co-operate, and it will be to their advantage to do so. Each will be represented on the Advisory Council and on the committees for those subjects in which it is interested. No programme of work can be forced on to a Province that does not agree to it.

Regarding the immediate needs of the central department, the present system of administration at Pusa by which the Director is Agricultural Adviser to the Government of India and also has under his charge Institutes at Muktesar and Bangalore, and the Joint Director is the Head of a Section, should be amended, and the post of Director be a whole-time appointment. Nowadays the Agricultural Adviser's responsibilities tend to keep him away from Pusa for the greater part of the year, and out of touch with the work going on in the various sections, while the routine work of the Joint Director has grown to such proportions that time that might be usefully devoted to research is taken up by minor details of administration.

(*b*) and (*c*) *Dairy bacteriology.*—Dairy bacteriology is a subject the study of which is being held up both through lack of facilities and lack of skilled workers.

At Pusa there is no pasteurising or sterilising plant, and no dairy for butter and cheese-making. Investigations here have necessarily been restricted to those dealing with the production of clean milk, the basis for successful butter and cheese manufacture.

Soil fungi.—Our knowledge of the soil fungi of this country is limited to that of a few forms that are pathogenic to plants. The part played by fungi in the biological processes occurring in the soil and their influence on soil fertility needs investigation.

Soil protozoology.—There is no protozoologist in any Agricultural Department, central or provincial, and this subject is untouched.

Plant Physiology and Bio-chemistry.—The causes underlying susceptibility and immunity to disease in plants are unknown. There is urgent need of workers both on this problem and on those connected with plant nutrition.

Irrigation.—The influence of irrigation water on the biological processes taking place in the soil awaits study. Results important in their bearing on irrigation practice should be obtained from research on this problem.

Fibres.—The bacterial processes occurring in the retting of fibre plants and their influence on the quality of the fibre produced should be investigated.

Question 2.—Agricultural Education.—The only form of agricultural education of which I have experience is the post-graduate training in agricultural bacteriology at Pusa.

(*i*) Such training cannot be obtained anywhere else in India, and no suitable applicants for the course have been rejected on account of lack of accommodation.

(*iv*) The number of applicants for the course has been greater than the number of vacancies to be filled, but the qualifications of nearly all of them were far too low to justify their admission. Until the Provinces employ more bacteriologists and bacteriological assistants, I do not expect to see any increase in the number of well-qualified applicants for this course.

Question 4.—Administration.—By the Devolution Rules under the Government of India Act, agricultural research has been made a provincial subject, and the Central Government has kept control over only the Institutes at Pusa and Muktesar, to which have been added the Dairy and Animal Husbandry Institute at Bangalore, and the farms under the Imperial Dairy Expert, and the Cane Breeding Station.

The possible effect of these rules on agricultural research does not seem to have been properly considered or realised when the rules were framed, for their result has been the establishment of Departments of Agriculture in the various Provinces, entirely independent of one another and of the central department, and with no provision for promoting co-operation, much less co-ordination. An Advisory Council such as that mentioned in the answer to Question 1, should be able to do something towards improving the present position by furthering co-operation and co-ordination amongst the several Agricultural Departments of the country.

The sectional meetings of the Board of Agriculture, the Conference of Chemists and Bacteriologists, Mycologists and Entomologists respectively, provided the only means by which scientific officers in the various Agricultural Departments could meet together and discuss subjects of common interest.

The Conference of Chemists and Bacteriologists has not met since 1921, for owing to retrenchment in Provinces, enough money has not been available to pay the travelling allowances of a sufficient number of officers to form a representative gathering.

The revival of these meetings would be beneficial, for they assist in the free interchange of ideas among the officers who attend, and thereby further efficiency and co-operation.

The Central Government already supplements the activities of the Local Governments by the work done in the institutions at present under its control namely Pusa, Muktesar, Bangalore and the Coimbatore Cane Breeding Station. It may further usefully extend its operations by promoting research in the subjects mentioned under Question 1 (*b*), of which that on plant physiology in particular is urgently required.

Question 10.—Fertilisers.—(*a*) and (*c*) The amount of experimental work on manuring has been far too limited. This has been due to insufficiency of facilities and of staff for the planning and carrying out of experiments on a field scale. Improved, heavier yielding varieties of crops are being introduced every year, making greater and greater demands on the supply of plant food in the soil. Now the maximum benefit cannot be derived from an improved variety if a sufficient amount of available nutrients is not supplied to the plants; moreover large tracts of land in various parts of the country are known to be deficient in phosphates. Deficiency in nitrogen is perhaps even more marked. Further experiments therefore need to be carried out on a much bigger scale than has been done before, particularly in connection with the utilisation of the natural phosphate resources of the country, and the practicability of increasing the nitrogen supply of the soil by increasing the area sown with leguminous crops and green manures.

Oral Evidence.

A.2546. *The Chairman :* Mr. Walton, you are Imperial Agricultural Bacteriologist?—Yes.

A.2547. We have your note of evidence. Do you wish to add anything to what you have written?—Nothing at all.

A.2548. How about the site at Pusa so far as your work is concerned?—I am quite satisfied with it myself. I have been here for many years now.

A.2549. I think you might give the Commission an account of your own training and past appointments?—I graduated at first from Armstrong College, Newcastle. Then I went to Cambridge and studied mathematics and science and took the agricultural diploma, after which I went to learn practical work on a farm. I was appointed Supernumerary Bacteriologist in October 1912. I was away at the War for about 4 years; I came back as Assistant Bacteriologist and was promoted to my present appointment in April last year.

A.2550. Do you wish to say anything more than you have written in your note as to the internal administration of Pusa?—No.

A.2551. I think you have heard what the previous witnesses have said in the matter of team work to deal with particular problems. Do you agree with them?—At present there is no obstacle whatever. We are all perfectly in harmony on these subjects.

A.2552. Do you personally come into contact with the Provinces at all?—Very little. There are no other Bacteriologists in the Indian Agricultural Service.

A.2553. Is not that a reason why you should come into closer contact with the Provinces?—I could only come in contact with the Chemists. I myself have been busy getting things in my own section into ship-shape order. I have been doing what I can to get into touch with the Provinces. Occasionally I am asked for information and I always supply it to the best of my power.

A.2554. Do you expect to do any touring?—A little this year. Last year I went to Bangalore, where we have the Imperial Dairy Institute, and to Karnal. I also went to Calcutta in connection with some research on the disease of *pan.*

A.2555. Is most of your work of a general nature, such as would apply to the whole of India?—Yes, I think it is.

A.2556. Although, as you just told the Commission, you do have to deal with special problems coming from particular localities?—There are special problems, but, from what I know about them in the Provinces, some of them are much alike.

A.2557. Are you in touch at all with the Imperial Dairy Expert, so far as dairy bacteriology is concerned?—Yes, I had to go down to see him and I gave lectures to the batch of students which recently passed out; there was nobody else to give the necessary instruction.

A.2558. Are you expecting any more courses?—There is a batch at present engaged, and I shall be consulting the Imperial Dairy Expert about the lectures.

A.2559. How many students are there in the present batch?—When I was at Karnal I saw 7; I do not know how many really there are, as some of them were away at that time.

A.2560. Are they coming here?—No, I should have to go to Bangalore; I did that the first year.

A.2561. What about the calibre of the men that you had in the last batch?—I was with them for a short time, and I was quite favourably impressed with the majority of them.

A.2562. What is the scope of the bacteriological course that you have given?—I gave them a little instruction in general bacteriology, but I gave special attention to the methods of production of clean milk.

A.2563. Where does your work end and the work of the Mycologist begin with regard to soil fungi?—Soil fungi is a thing on which nothing has been done; it is one of the subjects I have mentioned requiring research.

A.2564. But to which section would it naturally belong?—That I can hardly say.

A.2565. I thought there might be an accepted classification. Do you yourself see ahead of you a great deal of work?—I can see enough to keep me well occupied for the rest of my service, and two or three men after me.

A.2566. How do you decide which problem to tackle first?—I have inherited a good many; at present I have got sufficient to keep me going. The nitrogen problem of the soils is one to which I have given special attention; there was a recommendation to that effect passed by the Board of Agriculture some 5 or 6 years ago.

A.2567. Are you in touch with the rest of the world, so far as that work is concerned?—Through publications.

A.2568. Publications only?—Yes. Of course there is not, probably, anybody with whom I can get into touch in India; some Provinces have done a little work on that subject but not much.

A.2569. I see that you boldly advocate that the Central Government should finance the Advisory Council which you suggest?—So long as the finance is found, I do not mind who does it.

We find a good many people accommodating in that respect; I will not press you on the point.

A.2570. *Sir Ganga Ram :* Can you tell us something about nitrifying bacteria?—I could hardly do it at this stage; I can explain the subject to you in my laboratory.

A.2571. That is the thing I want to know something about. The long list of other subjects that you have given has not been investigated for want of funds?—I have mentioned the subjects as calling for research.

A.2572. *Sir Thomas Middleton :* You point out that there is no work being done on soil fungi or soil protozoology?—None that I am aware of.

A.2573. You have had no opportunities of working on soil protozoa?—I do not touch that subject.

A.2574. Do you touch soil fungi at all?—I really have not been able to deal with them at all.

A.2575. Pusa has sanction, I think, for the appointment of a Bio-chemist, but that is in another section?—Yes, in another section.

A.2576. Do you, in your own work, feel the need for a Plant Physiologist?—It would be of very great advantage and help to me in my work.

A.2577. If you had a Plant Physiologist working beside you?—If there were a Plant Physiologist in this Institute.

A.2578. What previous experience have the students at the Dairy Institute had?—I really do not know about that. I only went down to give them the minimum of instruction in dairy bacteriology, to qualify them for the diploma.

A.2579. Have any of them been through an agricultural college?—I do not think any of them have been through an agricultural college.

A.2580. The course in bacteriology consists of lessons on clean milk production?—I taught them a little about the ripening of cream and so on, but it was clean milk production that I laid special stress upon.

A.2581. *Professor Gangulee :* In this list of researches that you have given, you point out: "The causes underlying susceptibility and immunity to disease in plants are unknown. There is urgent need of workers both on this problem and on those connected with plant nutrition." On this particular item of research, are you in collaboration with the mycological section?—There is nothing done on it; this is a subject which I have mentioned to be taken up. I collaborate with the Imperial Mycologist; I see him every day and we generally have some little discussion together.

A.2582. Is it due to lack of staff?—The whole thing reduces itself down to the lack of staff.

A.2583. And you consider it is a very important point. With regard to the next item, the influence of irrigation water on the biological processes, this also could not be undertaken?—It was a matter put forward many years ago, but there has never been any staff to carry out the work.

A.2584. Are you in touch with any experiment irrigation stations where they are carrying on an investigation of that sort?—I only see the publications. When I go Home on leave, I go and have a look round.

A.2585. With regard to the retting of fibre, are you in touch with Mr. Finlow?—He has got one or two assistants who are trained in bacteriology and who have been doing the work, but they are not enough.

A.2586. In your department, there are not enough workers to carry on these items of research that you have mentioned?—There are far more subjects for research than workers able to carry on research.

A.2587. The provincial departments have no Soil Biologists?—They had one in Madras, but that post was abolished. I am in the same position here. In 1920 there was an Imperial Bacteriologist and 2 Assistant Bacteriologists; they were members of the Indian Agricultural Service. Those 3 posts were all filled up. I was one of the Assistant Bacteriologists; the other man died and his post was abolished by the Inchcape Committee. When Mr. Hutchinson retired, I succeeded him.

A.2588. And yet, from the agricultural research point of view, soil biology is a main necessity?—It is a fundamental necessity.

A.2589. Are you aware that lately the Indian Tea Association has appointed a Soil Biologist?—I have heard that they have appointed one.

A.2590. Are you in touch with him?—My attention has been drawn to the fact that they have appointed one.

A.2591. He is tackling very important problems on nitrogen; it would be very useful if you were in touch with him. With regard to education, you say that the qualifications of the applicants for the course are far too low to justify their admission. Do you mean to imply that in our Universities there is no scope for the study of biology? What are the prospects for the students taking this course?—I have said that there are no posts for the students. As a matter of fact, all the students that have gone through the course are now employed, and though they have got posts, there are no definite prospects of any posts.

A.2592. You have got a Dairy Expert?—Yes.

A.2593. He is in touch with you?—Yes.

A.2594. Constantly in touch with you?—Yes.

A.2595. You go there for the teaching work?—I have been there to teach.

A.2596. They appoint you to teach the course?—That was for the first batch, and it was an emergency arrangement; but if these courses go on, we will have to put the bacteriological course on a permanent basis.

A.2597. At the present time, you have no post-graduate students in your department?—I have one.

A.2598. Does he come from the service, or is he an independent student?—He has come here as a private student.

A.2599. What problem is he tackling?—He came knowing nothing about soil bacteriology. That is the trouble with all the students in this section; every one who comes, unless I get one who has been an assistant to an Agricultural Chemist in one of the Provinces or one who has taken a course in

Agricultural Chemistry, comes knowing absolutely nothing about quantitative analysis as used in agricultural chemistry, and he has to learn it.

A.2600. Is there continuity of research in your department? When you get hold of a problem, you see it through?—I carry it on as far as I can.

A.2601. Would you like to see this Institute developed into an Imperial College of Agriculture?—I have never considered that matter.

(The witness withdrew.)

The Commission took oral evidence of Messrs. J. Henry, C. G. Atkins and Ganga Vishnu on the 12th and 13th January 1927, for which see Volume of Evidence for Bihar and Orissa.

Thursday, January 14, 1927.

PUSA.

PRESENT:

The Marquess of LINLITHGOW, D. L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.
Rai Bahadur Sir GANGA RAM, Kt., C.I.E., M.V.O.
Sir JAMES MACKENNA, Kt., C.I.E., I.C.S.

Mr. H. CALVERT, C.I.E., I.C.S.
Raja Sri KRISHNA CHANDRA GAJAPATI NARAYANA DEO of Parlakimedi.
Professor N. GANGULEE.
Dr. L. K. HYDER.
Mr. B. S. KAMAT.

Mr. J. A. MADAN, I.C.S. } (*Joint Secretaries.*)
Mr. F. W. H. SMITH. }

The Imperial Agricultural Department (Pusa) Association, Pusa.

Replies to the Questionnaire.

Introduction.—The Imperial Agricultural Department (Pusa) Association came into existence in June 1925. It represents scientific Assistants of Class II and subordinate services, fieldmen, setters, artists, and the ministerial staff of the Institute. It has been formed with the object of (1) promoting co-operation and unity amongst its members, (2) securing by joint action an improvement in the amenities of service, (3) discussing questions affecting the common interests of the members and deal with them, (4) ascertaining and formulating the views of its members on all matters concerning which it is deemed expedient to communicate its views to proper authorities or to Government. Its members come from various Provinces in India.

The Association believes that as in India 71 per cent of the population depends for subsistence upon agriculture and its allied industries the improvement of agriculture and rural conditions should continue to receive paramount consideration at the hands of the Governments in India. If we but cast a glance at the agricultural backwardness of this country as revealed in its figures of yield of various crops per acre, we realise at once what a tremendous leeway has to be made before we can come into line with other agricultural countries of the world. The average yield of ginned cotton in India per acre is only 98 lbs. whereas in the United States of America, it is 150 lbs. In the case of wheat, the average yield in India is hardly 10 maunds per acre whereas in Great Britain it is 31 bushels (24 maunds) and in Canada and Australia even higher yields are reported. The yield of rice which is a staple food crop of a large proportion of population is 1,200 lbs. per acre in India whereas in Spain, Italy and Japan the yield is 2,000 lbs. per acre and over. The yield of sugarcane in Northern India is hardly over 10 tons of cane per acre whereas in Java, it is 43·2 tons and in Hawaii 45·5 tons.

These examples will suffice to show that agriculturally we are not producing as much as we should and even admitting that on account of differences in local conditions of soil and climate we may not be able to reach the higher standard prevalent in other countries, it at least gives us confidence that if well-directed and sustained efforts are made with a view to bring about a really better state of things those efforts shall not be in vain. Besides, India

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is now coming more and more in close contact with other countries of the world. Steamship communication and railway facilities have opened the door for India's produce to be placed in foreign markets at the competitive rates which now prevail in the world; we must therefore raise our produce at such an economic figure that we may not only be able to compete but also to secure a good margin of profit for our cultivators. If we do not increase our production and at the same time lower our costs per unit, the Association is afraid that in some of those commodities in which India has to compete with foreign countries in the export markets, we shall not only lose our hold with disastrous consequences to our agricultural community but also our domestic markets may be invaded by foreign producers as they have done in the case of sugar.

In these days of keen competition not to advance is to fall behind and consequently earnest efforts should continue to be made to ascertain by research, experiment and in other ways whether the existing condition of agriculture and rural economy cannot be improved.

QUESTION 1.—RESEARCH.—(*a*) The Association holds that the Government of India should only exercise very limited powers of intervention in those departments which are Transferred subjects in the Provinces. The Central Government should however arrange to bring about greater co-ordination. This is more necessary because there are crops which are common to more Provinces than one such as rice, wheat, tobacco, sugarcane, cotton, and a Central Government with its staff can bring the knowledge of the crop acquired in different Provinces to the notice of individual Provinces and give the requisite help when a particular Province is either deficient in staff or other facilities for research work on that subject. It will be also economical, as otherwise each Province will have to maintain a separate well paid staff and much unnecessary overlapping of work would result.

Further, there are certain fundamental problems such as determination of water requirements of crops, determination of soil temperatures, soil gases and available phosphoric acid in soils; problems in soil and dairy bacteriology and animal nutrition; manurial problems such as the economic utilisation of green manures and natural phosphates which are not likely to be taken up by the Provinces either because problems of a more pressing nature likely to give results of direct application in the near future are crying aloud for investigation or because the Provinces have not got the necessary funds to provide the requisite staff and the laboratory and other facilities.

With the growth and development of the work of the department along research and regulatory lines, it is highly essential that definite provision be made for the closer co-ordination of these activities through a central agency. Only in this way can the most effective results be obtained. Every effort should also be made to bring about a further correlation of the research and regulatory activities with those of the appropriate provincial agencies. The department has no adequate machinery at this time for attaining this object. The Association therefore thinks that a Central Advisory Council composed of the representatives of the various Departments of Agriculture in India, representatives of the Irrigation, Education and Veterinary Departments and also representatives from the agricultural classes should form the nucleus. Commercial and industrial interests should also be represented on this Council. This Advisory Council should form different sub-committees with different duties to discharge, such as agricultural science, agricultural economics, agricultural education and propaganda on the same lines as the Indian Central Cotton Committee.

This Council should have a fund of its own, built up gradually either by direct grants of money from the Central revenues or by a small cess on the agricultural products which are exported or by both. This Development Fund should be expended for purposes of Agricultural Research, Education, Research Scholarships and Travelling Fellowships. The Provinces according to their needs as in the case of cotton research, may have an adequate share. All the schemes drawn up by the Council should be submitted to the Standing Finance Committee and scrutinised by them, the final sanction resting with the Government of India. The idea underlying this scheme is that more frequent contact will bring all the departments into closer affinity and a sort of brotherhood will be established between the workers of the various departments. This sense of sympathy and comradeship is in the opinion of this Association the foundation on which successful organisation should rest. For further co-ordination, the Association would like to emphasise that early efforts should be made to revive the sectional conferences which only four years ago were abandoned. These conferences provide a meeting ground for all the research workers and by the exchange of thoughts and ideas considerably stimulate research spirit. It would be worth while to suggest that the sitting of these conferences should be held immediately after the session of the Indian Science Congress and if possible at the place where that Congress has met. The reason for emphasising the point is obvious. The opportunities thus afforded will widen the outlook of the research workers of the Agricultural Departments by their coming in contact with leaders of thought and culture in the domain of science in India. In other countries these opportunities are afforded by the various associations which do not exist in India. These meetings both in their official and social aspects have considerably contributed to the promotion of research and have therefore been organised year after year, but unfortunately in India this aspect of the organisation of research has not been properly appreciated.

The Association urges that the organisation of these sectional meetings should be taken up by the Central Advisory Council.

Publications.—The delay in publication of the results obtained by research workers in the various Departments of Agriculture in India hampers to a great extent the progress of research. Further, before accepting the results for publication, the Association thinks it proper that they should first be examined by a Board of Editors—a body under the Central Advisory Council and appointed by them. In the case of various journals in England and America the Editorial Board consists of persons from all parts of the world who are pre-eminent authorities on the subjects the journal deals with. The advantage of this system over the existing one in India is that proper scrutiny and valuation of the papers is made, suggestions for improvement from authorities are forthcoming and these substantially improve the quality of the work published.

Library.—The Pusa Library which is the best of its kind in India leaves ample room for improvement. If it is made as comprehensive as possible, the needs of the Provinces can very well be served by this Central Library. The cataloguing system should be more elaborate so as to enable research workers to find out the references at one place in the card cabinet without having to search out amongst the papers in the cupboards. The system of cataloguing as has been resorted to by the United States Department of Agriculture for their own use as well as for the States should also be attempted here so as to enable the research workers of the various departments to be in touch with the progress of knowledge.

Post-Graduate Training.—Assuming that the Pusa Institute will be converted into a temple of research and higher training an improvement in the post-graduate training imparted here is called for. Under the present conditions the students coming here for training have no other attractions than training in research as the Government do not promise or guarantee appointments. If in addition to this inducement, another attraction on the following lines be introduced, the Association thinks that the popularity of this Institute will be greatly enhanced and men of the right type and calibre will be forthcoming. This Institute should be affiliated to some of the leading Indian Universities to enable these scholars to obtain a degree of Ph.D. or D.Sc. on the merit of a thesis after completion of 2 years' research work. Provision should also be made to send some of the selected students to foreign countries for additional training and experience.

Recruitment.—The number of recruits will thus largely depend upon the number of scholars available in this Institute. The recommendations of the Lee Commission which are being acted upon by the Government in so far as the policy of recruitment in India is concerned will lead to the appointment of a large number of Indians to the Superior Agricultural Services. Assuming that the students who have undergone post-graduate training at Pusa will offer an extensive field for choice of candidates, the Association considers that the case of subordinate services should also receive consideration. The Association therefore recommends that a fair proportion of the appointments in the higher service should also be made from deserving candidates from the lower group. Such promotions will make the department more efficient by attracting capable men and utilising their extensive experience. As a rule the highest position in services should rather be earned gradually than attained at once as in other countries except in special cases. On their promotion they may be sent abroad if necessary.

Agricultural Organiser's Services.—The Association is of opinion that paucity of knowledge regarding the indigenous theory, traditional methods and the existing conditions of agriculture and its problems is a great setback to any kind of progress. The agricultural classes are generally illiterate and meet with problems, the existence or importance of which they are unable to recognise but real progress depends on their solution. Until therefore a systematic survey of their problems is made for them, the amount of labour and money spent on unsystematised research will not do much good to the country.

In order to fulfil this object an Agricultural Organiser's Service may be instituted. These officers will be men of the same Province in which they serve and along with this work should be charged with propaganda and actual field demonstrations on the cultivator's lands. These men will report quarterly to their respective Heads of departments who after allocating the various problems to various officers for solution will report to the Central Advisory Council who will take all necessary steps for the solution of the remaining problems which the Province could not undertake either for want of efficient men or for other facilities such as funds or laboratory provision. If in this way a systematic survey is made of the problems a system of research will be built up on a more satisfactory basis.

(*b*) *Field and Laboratory Facilities.*—The laboratories at present in existence have ample accommodation and are efficiently equipped. But if we compare the output of the Rothamsted Experiment Station with the work turned out at Pusa we suffer in comparison. The reason for this is either want of skilled workers, or deficient organisation.

Slight alterations or modifications in the laboratory equipment and field arrangements as may be necessary according as new investigations are taken up, can be carried out at no great expense.

Skilled workers.—The Association is inclined to think that the right type of men has been wanting in the department. If one glances at the past history of this department, it will be found that research has been taken up in a very unsystematic way. In all research on crop production, crop nutrition, etc., soil plays the most important part, climate having its own share to contribute. But unfortunately soil survey has been ignored and still hangs large before the research workers.

Other problems such as those of plant physiology, plant pathology which are dealt with under (*c*) have also not been taken up either for want of skilled workers or for financial reasons.

Handicaps.—(1) *Standardisation of methods.*—An extensive series of analyses has been carried out by the Central as well as Provincial Agricultural Departments on soils, manures, food and feeding stuffs, etc., but either for lack of co-ordination due to deficient organisation or for want of skilled workers, the analyses have not yet been corrected and standardised. Standardisation of methods is of great value to research workers inasmuch as it helps to find out the accuracy of the results obtained by them through comparison and save a great deal of preliminary spade work.

(2) *Lack of knowledge of cultivator's problems.*—The lack of knowledge of the various problems confronted by the agriculturists in the course of their

actual field work is also an impediment to the systematic investigation on scientific lines. Agricultural experts who are recruited from abroad are sometimes inclined to transplant the methods obtaining in their country without modifying them according to the local conditions. The improvement attempted hitherto in cattle-breeding by crossing the country cows with imported bulls is an instance in point. In the case of agricultural implements too, foreign implements which are constructed to suit the conditions of their soil, etc., used to be recommended in early days for use in India without making adequate allowance for the financial limits of the agricultural classes and also the practicability of their use in the fields. To give an example: the Inversion Plough was introduced in the Central Provinces and was found too heavy for a pair of bullocks. This plough was subsequently modified and can now be had at about half the original cost while it has been equally serviceable.

(3) *The language difficulty.*—The language difficulty in the case of European experts and the official position of the experts furnish another set of handicaps. The experts cannot very often get into close touch with cultivators to study the actual practice of agriculture for the improvement of which they are primarily intended and have not infrequently to depend upon their subordinates for collecting first hand information.

(4) *Touring facilities.*—Touring facilities should be more extensively given. The study of local conditions relating to a particular problem undertaken by an Assistant makes this all the more necessary.

(5) *Lack of industrial facilities for investigation.*—There are certain investigations which are undertaken in the laboratory and which on account of their economic value can be expanded commercially. The lack of facilities for this kind of investigation further leaves the research worker at a stage where no other commercial country would allow him to stop.

(6) *Lack of comradeship in the laboratory.*—The existing distinction between the Imperial, Provincial and Subordinate Services tends to produce a harmful effect on the working of the departments. The marked difference in pay, prospects and status of these services constituted and officered as they are at present, requires to some extent a readjustment as these differences would ordinarily create an artificial sense of superiority in the members of the higher branches and thereby very often prevent the feeling of comradeship amongst scientific workers which is highly desirable but which is under existing differences hardly attainable.

(*c*) The Association is of opinion that adequate attention can be usefully directed to the following lines of research:—(1) soil survey of typical tracts, (2) utilisation of natural phosphates, such as Bihar apatites and Trichinopoly nodules and bones for manurial purpose, (3) value of different natural and artificial manures in different types of soil, (4) food value of grains, pulses, vegetables, fruits for human nutrition, investigation into deficiency diseases, (5) standardisation of analytical methods of soil and manurial studies, (6) problems in soil and dairy bacteriology, (7) manufacture of manures and milk products, such as, casein, milk powder, and other agricultural products, *e.g.*, egg powder, (8) reclamation of acid and alkali soils, (9) problems in soil physics, (10) problems in plant physiology; plant pathology; seed testing, (11) statistical studies of crop and weather for forecasting purposes in different Provinces, (12) dry farming conditions, (13) agricultural technology and chemical engineering, (14) horticulture and fruit preservation.

QUESTION 2.—AGRICULTURAL EDUCATION.—(i) The Association as it is constituted of members representing all the Provinces in India is in a position to say that the institutions for imparting agricultural education are comparatively few and the number of teachers also proportionately small. There is one agricultural college in each of all the Provinces except Bengal, Bihar, and Assam and that is sufficient for the purpose that these colleges are serving at present.

There is only one institute, *viz.*, the Pusa Agricultural Research Institute which admits students for post-graduate studies. In the colleges as well as the Pusa Agricultural Research Institute the supply of teachers is sufficient.

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(*ii*) In every Province in India there is room for extension of teaching facilities for agriculture in schools as opposed to agricultural colleges but agricultural education of the right type in accordance with the requirements of the agricultural classes and with reference to particular local conditions should be imparted.

(*iii*) Teachers if drawn from the agricultural classes or from those who have gone through an agricultural course will be better able to impart education to their pupils according their needs, with which they are already conversant.

(*iv*) For reasons stated in (*ii*) above, the attendance even in existing primary schools is far from satisfactory. Primary education should be free. Agricultural classes can hardly afford to pay the school fees for the education of their children. For grown up children of an age above 10, arrangements should be made to impart instruction in the slack season. At this age they are useful in day time on their father's lands and they cannot attend day schools, in the busy season. First, education should be given on the lines of elementary reading, writing and arithmetic, and then a general training in agricultural methods and operations supplemented by facilities for vocational training in weaving, spinning, carpentry, smithy, and clay-modelling. The product of their labour should be sold and a portion of the profit given to the boys. Training in agriculture should be made attractive by teaching the boys how to solve the agricultural problems of the locality. This will make them useful on their own lands and induce them to apply improved methods of agricultural operations. Education of such practical nature in the opinion of the Association is very likely to stimulate a demand for instruction in rural areas. The attendance at agricultural colleges is so far as we know sufficient.

(*v*) Under the existing conditions boys take up a study of agriculture for the purpose of employment in Government service or elsewhere. As the agriculturists cannot now maintain themselves on the profits accruing from their lands, they expect earning money outside, for which they send their boys to schools.

(*vi*) In places where there are stipends for boys of agricultural classes, agriculturist's sons attend schools; otherwise their number is very small.

(*vii*) Modifications in existing courses of study in schools are earnestly needed. They have been outlined above in (*iv*). In the agricultural colleges that are affiliated to the Universities, changes in the course of studies are taking place owing to the pressure of public opinion.

(*viii*) Provision for teaching nature study, is needed for proper education. Plots given to boys should be run on an economic basis, so that boys may learn that their labour is paying, which will create confidence in them; without such arrangements practical training will be incomplete. On the farm plots attached to the schools large scale operations should be taught and how they may be made paying.

(*ix*) A great majority of boys who have studied agriculture in agricultural colleges are in service under Government or elsewhere and very few of them have taken to farming on their own account. Lack of capital and fragmentation of holdings contribute not a little towards absence of independent farming. A connecting link between the collegiate education and actual farming is required to give that confidence with which one can undertake farming as a business.

(*x*) Please refer to answers (*iv*) and (*viii*) above. Agriculture can be made attractive to middle class youths provided some capital and decent sized blocks of land in a convenient place are made available. Capital may be supplied by co-operative credit societies on long-term loans at a low rate of interest. Cultivation of small holdings if conducted on a co-operative basis, the produce being distributed to the owners according to the area owned by them and the fertility of their lands will probably assist in this direction.

They should have a training in subsidiary industries too, such as poultry-keeping, dairying, sericulture, weaving, etc.; to which they may turn seriously in slack seasons and at other times they may arrange to carry them on with occasional supervision.

(*xii*) Agricultural classes are generally engaged in the fields at day time. Night schools and schools for limited periods in the off-season will therefore be required for their instruction. The Agricultural Organiser's Service referred to in answer to Question 1 will be conversant with the problems and difficulties of the agricultural classes. Solutions of these should be explained in these schools and demonstration given on model farms referred to in Question 1. Practical instruction of this type, the Association thinks, will be popular among adults in rural tracts.

(*xiii*) Suggestions for better educational facilities in rural areas have already been outlined above. Their administration should be vested in the Union Board or the panchayat supplemented by the supervision of the Education and Agricultural Departments.

The financial help should be partly rendered by the Local Board and partly by the local landlords whose tenants will be receiving instruction in these schools. Education should be free; but a portion of the profits accruing from school plots and school farms should go to the school fund; and the same principle should apply to subsidiary industries, such as carpentry, spinning, weaving, clay-modelling, etc., which will be run by the school students.

Besides answering the specific points in the Questionnaire, the Association would like to give its ideas as regards agricultural education in the following paragraphs:—

> *Agricultural Education,* as a whole can be divided into three classes:—(1) elementary, (2) middle or high school, (3) education in agricultural colleges including education for research.

(1) Separate agricultural schools have not proved and will not prove successful in all cases, nor is there any clear necessity for these as yet. As soon as the boys complete their elementary education, studying nothing but vernaculars, mathematics and nature study, they should be given the choice of taking agriculture and vocational training as an optional subject with English or vernaculars and mathematics only. After the completion of their middle school examination only bright students of good means, who will be in a position to go through their college education should be permitted to take up elementary physics, chemistry and botany as additional subjects, as a substitute in part for general agriculture, *i.e.*, they will have to devote a little less time to practical agriculture than their less brilliant fellow students, who may either leave the schools or continue their education up to the Matriculation standard with more devotion to practical agriculture. This will necessitate a revision of the syllabus for the Matriculation examination. Students of such qualifications will be better practical farmers or managers of their own farms. It is from this sort of educated cultivators that one can expect rapid adoption of modern methods of cultivation. It is they who will be able to understand the principle of co-operation and form co-operative sale and purchase societies and agricultural discussion societies. They will be in a position to make use of pamphlets or other advisory publications pertaining to agriculture or sanitation.

(2) *For training the students* in high schools it will be necessary to maintain a school farm for each school or one farm for a number of schools if they happen to be at one place. There should be at least one high school with a farm when a number of schools are situated at one place, so that those students who wish to take agriculture might join that school.

The size of the school farm should be from 100 to 200 acres managed by the Agricultural Department. In fact such farms will be more useful than the demonstration farms because these will be often visited by the parents of the students.

To teach agriculture in high or middle schools teachers should be graduates of an agricultural college. They should be controlled by the Education Department. These teachers in consultation with the Superintendent of farms will plan out their schemes for practical demonstrations to the students.

(3) As is the practice at present, there should be a four years' course after the Matriculation in each college of agriculture for general agricultural education, a five years' course being provided for specialisation in particular subjects. Up to four years students will go through the same course and will be qualified for the degree of B.Ag. Students wishing to specialise will have to undergo another year's training after the completion of their B.Ag. course and the successful candidates may be awarded a degree of M.Ag.

Research students with M.Ag. degree should be selected for training in agricultural research at Pusa. Here after two years training, on the submission of a thesis, they should be awarded the degree of D.Sc.

Agricultural graduates taking the B.Ag. degree will be found useful as farm managers, demonstrators and teachers. They may also be employed in the Irrigation and Revenue Departments which are closely connected with agriculture. The employees of these departments often come in contact with the cultivators, and as such they can render more help to the cultivators if they are persons of agricultural qualifications than the staff recruited as at present.

QUESTION 3.—DEMONSTRATION AND PROPAGANDA.—(*a*) The measures adopted by the Bombay Department of Agriculture are in the opinion of the Association the most effective ones. When the distribution of seed is made the department guarantees the grower against loss. Improvements suggested by the department are usually after a study of the local conditions, the requirements of cultivators, their means and after satisfying themselves that to adopt them would pay the cultivator. Efforts to reach the cultivators by means of leaflets in vernaculars, through agricultural associations, co-operative societies, demonstration staff, etc., are being made in some places. Both in the introduction of a new crop or varieties of crops and in tillage implements the Bombay Department has achieved a large measure of success.

(*b*) The demonstration of improved methods of cultivation or growing a superior variety of crop or in the use of better implements should be carried out by departmental agency on the royt's lands to convince him that the department's methods are a decided improvement. Side by side a demonstration should be given to show the difference in results obtained by the old methods or implements. When a new variety of crop is being introduced, there should be two plots side by side and of such size that the cultivators can judge for themselves at a glance the superiority of the new variety over the local one. Arrangements should also be made whereby the ryot can get the new seed or implement without much trouble and he may be enabled to sell the produce of his superior variety at its proper price. When a new implement is introduced, some arrangement for repairs locally is also required to be made.

(*c*) The Association thinks that attempts should be made by the Government on the following lines to ensure success under this head. Generally the experts or scientific officers are not within easy reach of the cultivators. To improve this state of things every Union or panchayat should have one model farm run by the department. Secondly, the cultivators are as a class suspicious of any Government agricultural concern. In order to persuade them to take up improved methods earnest efforts should be made by the department to induce the landlords to open a farm on the lines of the model farms. Thirdly, the illiteracy of the cultivators is a great barrier to their grasping the true nature of the problems or of the results of scientific investigations. Demonstrators on the model farms should be made to go round the villages by turns, hold sittings after nightfall with a number of villagers, discuss with them and try to explain the value of the results obtained in the local dialects. To supplement this activity, leaflets written in a very non-technical and easy language should be circulated among the agriculturists either through the Union Board or postal peons. The demonstrators will also be required to explain leaflets to them.

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QUESTION 4.—ADMINISTRATION.—(*a*) At present the Agricultural Departments in the Provinces are Transferred subjects in charge of Ministers. Each department works on its own lines and there is no connecting link between a department in one Province and that in another except through annual reports and other publications and by a biennial meeting of the Board of Agriculture where programmes and other important problems bearing on agriculture are discussed. We would suggest that greater facilities be provided for the workers in one Province to meet workers on the same problems in other Provinces so that experience gained in one Province may be utilised to the best advantage. In this way unless called for by varying conditions of soil and climate, duplication of work will be avoided. Conferences of selected workers from each Province in each major branch of scientific research should also be provided as these will help in promoting a better knowledge of the problems that are being tackled, the lines of investigations which are to be dropped and the reasons therefor as well as the lessons to be drawn from these failures.

(*b*) As agriculture is such an important basic industry, the Government of India should maintain a staff of specialists who will investigate problems which are common to more Provinces than one and which each provincial department may not be able to tackle, itself, unaided. In the Association's opinion specialists for crops like tobacco, rice, wheat, sugarcane should be entertained by the Central Government to undertake research work and to give help to any Province which may sorely be in need of it either for financial reasons or for want of proper staff and equipment. As far as possible the Provinces should be encouraged to expand their own departments and to provide for work on almost all major problems that require attention. It will however still be the case that some problems which have been relegated to the background may suddenly assume an altogether increased importance and on such occasions the local department should be able to draw upon the central department for assistance.

(*c*) (*i*) The Agricultural and Veterinary Services still require considerable expansion and the Association would consider that until at least one veterinary hospital is provided at the headquarters of each taluk and until a small agricultural farm is provided in each taluk so that the people may be familiarised with the existence of these two departments and their beneficient activities, the public will not remain satisfied.

(*ii*) As regards the rates charged by the railway companies, freight rates at present for manures, implements, etc., are rather high. The railway should also provide cold storage facilities for transport of milk by rail. This will enable milk to be brought to cities from distant places and also encourage the dairy industry. The goods traffic is not handled as expeditiously as in other countries and an improvement is called for in this direction also.

(*iii*) *Roads.*—In many parts these are either *kutcha* or not sufficiently strong to bear heavy traffic. The bridges are not strong enough and in many places they are practically useless during floods. More roads and those too metalled as far as possible are necessary, as at present a lot of unnecessary strain falls on the bullocks and carts get broken on indifferent roads. In some parts of Bihar carts are not allowed to go on the *pucca* roads except in the rains and the cultivators have to use what may by apology be only called *kutcha* roads. This state of affairs requires to be improved.

(*iv*) Important weather reports or meteorological observations should be within the easy reach of cultivators. The reports may be hung in village post offices or other places of public interest.

(*v*) Vernacular leaflets bearing on agriculture should be distributed free by post.

QUESTION 6.—AGRICULTURAL INDEBTEDNESS.—(*a*) (*i*) Among various causes that lead an agriculturist who does not believe in money savings and perhaps has only a few ornaments as a set-by to borrow money, may be mentioned:—(1) expenses connected with social and religious ceremonies, (2) lack of ready money for payment of rent and additional taxes, (3) sudden loss of cattle due to outbreaks of epidemic, (4) purchase of seeds and manures, (5) famine, general or local, (6) thefts and accidental fires, (7) prospective improvement of his farm, *e.g.*, digging a well.

(*ii*) The only persons from whom the agriculturist can borrow in a great majority of cases are the moneylender or his landlord. *Taccavi* loans from Government and advances from co-operative societies are also drawn upon by agriculturists. The credit of the agriculturist depends on his land, the number of cattle, ornaments, house, and personal character. Of these, ornaments and personal credit are the assets on which the agriculturist can depend with confidence.

(*iii*) Among the causes that prevent him from repaying his debt are:—(1) famine due to want of rains or failure of crops caused by excessive rains, diseases or pests, (2) improvident habits, indulgence in liquor, opium, *ganja*, and the like, (3) death in the family, (4) failure of anticipated profits from an investment in improving his land, (5) unnecessary litigation.

(*b*) *Unproductive expenditure.*—At present the Indian agriculturist does not correctly understand his economic position and he goes on in the way his ancestors followed when the holdings were comparatively larger, by borrowing money for any and every item of expenditure without considering whether he will be able to pay it off. Unless he is made to realise the economic position in which he is placed with the small holdings at his disposal, attempts at solving the problem by insolvency court or application of Usurious Loans Acts will not eradicate the evil for even if he be once freed from the debt there is no certainty that he will not incur the debt again. That the interest should be limited to a certain rate is reasonable but to guarantee to meet the claims of the creditor in other respects in full is necessary. Otherwise it is directly helping them to get out of it by dishonesty. So long as the *mahajan*, *sowcar*, big landholder, or *bania* is the only creditor willing to lend money and the agricultural banks or co-operative credit societies are not yet fully developed, it is not desirable to curtail the credit of the cultivator.

(*c*) If the cultivator is required to borrow money from sources other than the co-operative credit societies or Government, it is not advisable to control his credit in any way but to make him literate so that he may understand his economic position and the nature of the transaction that he is entering into. Limiting the right of mortgage and sale or any measures safeguarding the retention of his land will result in his losing all credit in the very market where by force of circumstances he will be compelled to go, the result being that for want of capital required at the proper time he will lose much more heavily and the very object of saving him will be defeated and he will ultimately be forced to abandon his land, if not to a *sowcar*, to the Government or to his fellow agriculturists.

Opening of more co-operative societies and encouragement of agricultural banks or the establishment of Panchayat Boards at whose recommendations *taccavi* advances may be made to the needy cultivators are some of the means that are likely to prove successful in ameliorating the conditions of the agriculturists.

A long-term credit at low interest would no doubt benefit the agriculturist. Limiting the rate of interest by law but giving the creditor the same facilities of recovering the capital and interest with fairness to the cultivator as is given to Government agencies or co-operative societies may meet present requirements satisfactorily to both parties. In case of disputes either the Panchayat Board or the civil court should fix the amount due to the creditor and the advance of that sum as *taccavi* to the debtor may be made for redemption of mortgage by the order of the court or on the recommendation of the Panchayat Board. In this way the really needy cultivator will get the *taccavi*, the creditor his just dues and the transfer of land to a non-cultivator would be prevented.

QUESTION 7.—FRAGMENTATION OF HOLDINGS.—(*a*) The Association would welcome means to prevent the excessive sub-division of holdings. The Hindu and Mahommedan Laws of Inheritance encourage fragmentation of holdings. These laws require to be so amended that agricultural holdings should not be sub-divided below a certain unit which may be considered sufficient to maintain a family in decent comfort. Those who are dispossessed of their share in land should get compensation in money.

(b) The obstacles in the way of consolidation are:—

(1) The inequality of land even in each village, and

(2) unwillingness of some to exchange their fertile land for another piece, however large, of less productive land. Land just near the village site commands more value while that at a distance considerably less. The obstacles can however be overcome if preparatory work is done in the village by educating the people in the benefits of consolidation. When two-thirds of the community agree the remaining one-third, if they are opposed to consolidation, should be compelled by law to fall in with the others in the general interests of the community.

QUESTION 8.—IRRIGATION.—The rivers in Southern India are gradually becoming silted up. The bunds are either not properly attended to or repaired in time, with the result that whenever there is a little more than ordinary flood in the river, breaches are reported causing destruction to standing crops. The feeding canals which take water from the main rivers are also kept in a neglected condition by villagers owing to lack of cohesion in villages and decay of the old panchayat system. Effective control of the irrigation branch of the Public Works Department and the Revenue Department would improve the matters to some extent. The village panchayat system should also be revived wherever possible with sufficient powers to attend to common needs of agriculturists such as looking after village tanks, etc.

In those tracts in which there is a dull season because of the absence of facilities for irrigation, every encouragement should be given to the cultivator to sink a well. Capital for this purpose should be made available to him at fairly reasonable rates with repayments extending over a sufficiently long period. This will benefit the cultivator in various ways:—

(1) He will find scope for employment of idle labour in his family; (2) it will render him to some extent independent of the vagaries of the monsoons; and (3) it will enable him to grow more paying crops by intensive cultivation where formerly only inferior millets and such other crops used to be grown. Incidentally it may be mentioned that as this water has to be raised from the well with labour which will have to be paid for by himself, he will be very careful in making that water go a long way and we shall be spared the evils of excessive watering which are noticed in areas commanded by canals.

Greater facilities should be provided in this direction by developing well-boring departments in the Provinces wherever there is scope for development in this line. The work done in this direction in the United Provinces and Bombay shows us how beneficial it is.

Wherever possible, the digging of tanks or reservoirs for storing of water should be encouraged, particularly in areas of precarious rainfall. The absence of tanks is a great hardship to cattle in the hot weather. Private companies for putting up installations for pumping water from small rivers and streams should be encouraged, as much of the water in such rivers and streams remains at present unutilised.

QUESTION 9.—SOILS.—(a) (i) Indian cultivated soils are generally lacking in organic matter which when added to the soils is soon oxidised away under the climatic conditions prevailing in this country. Naturally the replacement of organic matter in such soils would renovate them and the best methods to this end should be investigated. Proper attention to drainage and a study of physico-chemical factors, would improve some soils which contain excessive moisture, *e.g.*, clayey soils and clay loams in irrigated tracts, but in dry areas conservation of moisture in the soils is a great problem. The value of improvement of physical texture of the soil is as yet little realised. The importance of soil surveys in this connection has been dealt with elsewhere under Question 1 (*b*).

(*ii*) Methods applied for the reclamation of alkali soils in other countries are many and varied, but they cannot be transplanted here without first ascertaining the local conditions and the way alkali soils are developed in India, as soils differ widely in character in different countries. A proper survey of these soils, existing in different tracts, will show their nature, and a fundamental research into the causes of alkalinity in the first instance followed by the physico-chemical and biological treatments for reclamation will pave the way to sure success. Work hitherto done in this direction in India has not been systematic. Much work on the factors leading to the development of alkalinity in soils has been done in other countries. A reference to this work will show the way in which efforts should be made in this direction. In India some practical results have been obtained in different Provinces, but they cannot be considered as suitable for general application.

Flooding with water and washing out the alkali has given good results in some Provinces; while in others drainage of the whole irrigated tracts instead of individual fields is a great necessity which can be met by the department in charge of irrigation channels.

Among other measures that can be suggested, addition of organic manures and gypsum to alkali soils along with drainage is likely to give good results. Treatment with sulphur composts containing sulphur-oxidised-bacteria has been suggested as likely to be of use in improving the black alkali soils by neutralising the carbonates to sulphates and also improving the physical texture of the soil allowing it to drain more freely than before.

(*iii*) It is necessary to maintain the surface soil and prevent it from erosion. *Bunding* the fields as is done in rice tracts would prevent erosion by floods. Railway lines are in many places responsible for retaining flood water and causing great damage. The Damodar flood in Bengal a few years back is an instance in point. Proper bridges should be erected to allow the flow of excessive water due to such causes. Roads higher in level are also responsible to some extent. To remedy this evil contour maps of places where floods are common should be drawn, and roads and railway lines constructed accordingly, making allowances for the flow of excess water when occasion arises.

Arable soils which have gone out of cultivation or uncultivated soils including alkali soils from different Provinces have been dealt with in this Institute. *Manat* soils from Travancore, abandoned coffee estate soils from Mysore and some tea soils from Assam are some of the instances; and in many cases defects have been traced to the absence of some particular biological activity due in some cases to the entire absence of the necessary organisms, and in many others due to the absence of proper physical and chemical conditions for maintaining the bacterial activity in the soil. Restoration of the proper conditions by the necessary treatment has shown improvement in the condition of the soil, the normal bacterial activity is resumed and the fertility of the soil is restored. In some of the soils examined, total absence of the nitrifying organisms was noticed while in another nitrogen fixing bacteria were wanting. Excess of alkali, deficiency in lime and absence of proper physical condition led to the absence of bacterial activity in other soils. While it is not expected, as in the instances given, that absence of biological activity will necessarily be the root cause of the trouble in all such soils, it would not be out of place to suggest that a first examination of the soils be made from this standpoint, for it may be assumed that the resumption of normal bacterial activity of a soil is a sign of its natural fertility. If a systematic survey of such uncultivated lands along with a study of their biological, chemical and physical standpoints is made, practical remedial measures to bring them under cultivation could be suggested.

Some lands which are not fit for growing ordinary crops would however be used for planting trees for fuel if for no better purpose. That the raising of such plantations on uncultivated lands is a practical proposition can be seen from the casuarina plantations in the coastal districts of the Bombay

Presidency. Some lands in the coastal districts have gone out of cultivation owing to the wind-blown sand covering the cultivation thickly. For such soils there is no remedy except to take precautionary measures, *e.g.*, to plant some binding vines beforehand.

QUESTION 10.—FERTILISERS.—(*a*) There is ample room for expansion in the use of organic nitrogenous manures like the farm-yard manure, cattle urine, sheep folding manure, oil-cakes, fish manures, green manures, leaf mould and household refuse. Artificial manures are being used for certain paying crops like sugarcane, and tobacco, in vegetable gardening, fruit growing and on tea and coffee plantations. The use of the manures would however be limited by the needs of each district and of the particular cultivators. This subject should therefore be taken up by the Agricultural Organiser's Service who will demonstrate their use on cultivator's field and explain the reasons for the same by broadcasting pictorial pamphlets in vernaculars. Sometimes the cultivators do not use the fertilisers simply because they are not readily available and to order them in small lots is expensive on account of transportation charges. In the beginning there will be only a few people willing to use the manures in a village but their total number in the taluk, division or the district will probably be found to be considerable. In such cases district depôts managed privately should be encouraged and in the absence of any enterprising firm or co-operative society willing to undertake this business, Agricultural Departments might show the way by opening selling depôts which can also stock seeds and implements and other agricultural requirements, till such time as some private agency comes in the field.

(*b*) At present very few instances of fraudulent practices in manures trade have come to the notice of the public and until the trade develops much harm is not likely to be done to the agriculturist. If such a contingency, however, arises, legislation will have to be resorted to. A basis for such legislation has already been prepared by the Agricultural Chemists' First Conference held at Pusa.

(*d*) The use of fertilisers has been steadily increasing in tracts growing crops like sugarcane, tobacco, vegetables, plantains and coconuts and on mango plantations. Tea and coffee planters are already regularly using the fertilisers.

(*e*) The effect of different fertilisers has not been studied sufficiently in different types of soils met with in different Provinces. For such a study a committee on the lines suggested by the Conference of Chemists and Bacteriologists is necessary in order to consider this problem from all points of view so as to obtain complete data. When the scheme of experiments is approved by the committee the experiments may be carried out in any locality where their practical application is likely to be of use. If the cost of such experiments is met by the Central Government probably all Provincial Governments would be ready to have them in certain areas in their Provinces. Large tracts of land of a nature similar to the Gangetic alluvium and black cotton soil of the Deccan are distributed in more than one Province and it would be economical for the Central Government to so arrange the areas of experiments according to the types of soil as to suit two or three Provinces.

(*f*) Provision of some other cheap fuels is one of the surest means of discouraging the use of cowdung as fuel. We have already suggested the planting of trees in waste and uncultivated Government lands. The zamindars and big landholders may be induced to realise the value of raising cheap fuel in waste and uncultivated lands in their possession for the use of their tenants, if the land cultivated by them is to retain its fertility by manuring with cowdung. In ryotwari districts also the ryot may be encouraged to plant trees in waste lands, hedges, and borders of the fields and in common pasture lands.

Encouragement of wood distillation near forest area and transportation of bye-products such as charcoal would provide the fuel which is in large demand in cities like Bombay.

Installation of bye-product ovens instead of the present method of burning coal near pits for making coke in certain collieries in Bengal would also result in a considerable saving of fuel besides yielding bye-products such as ammonia useful for agricultural purposes.

Modified domestic ovens would effect economy in the fuel burnt and also in such ovens paddy husks and sawdust could be utilised to advantage.

Dry leaves composted with cowdung and charcoal under certain conditions would also increase the supply of organic manure at the disposal of the agriculturist. This is another direction of attacking the problem inasmuch as it converts part of the other sources of fuel into manure for which purpose the cowdung is intended to be saved.

Apart from the prevention of cowdung from being used as fuel it has to be pointed out in this connection that the cultivators in certain parts of the country require to be taught better methods of preserving cowdung and cattle urine in order to be more useful for manurial purposes than at present.

QUESTION 11.—CROPS.—(*a*) The improvement of existing crops can be carried out by selection, hydridisation and introduction of improved varieties from abroad. It is essential to know all the varieties under cultivation in the Province and how far they are suitable. If information on all the varieties of any particular crop is thus available from the different provincial departments it would be a great advance in the knowledge of crops. With this information will naturally follow the suitability or otherwise of the crop to particular localities. Wherever the existing variety is unsuitable, certain other varieties could easily be tried; if, however, none is found suitable on account of disease or lower yield or unsuitability to the consumer a new variety will have to be raised by breeding. The introduction of new crops from outside should be carried out under one central control, which should also take measures to ensure freedom from disease and pests along with the seeds, setts or grafts imported from outside. The distribution of these should be undertaken by the Agricultural Departments in the Provinces through suitable agencies like the co-operative societies, which will advise the cultivators to make their first trials on small areas in different localities before undertaking sowing on a large scale.

(*iv*) Many cases of damage by wild animals are reported by cultivators all over India. Measures to ameliorate the condition consists in wild-animal-proof fencing and destruction of wild animals by killing or shooting clubs. In some cases research in the life-history of the wild animals like the pig is suggested. A professor of zoology in any of the Indian Universities may be induced to undertake such a study on a suitable grant being given by the Central Government. This method of attacking the problem would be much cheaper than engaging special experts and should be tried.

QUESTION 12.—CULTIVATION.—(*i*) Cultivation of soils to a greater depth than what is being done at present is very likely to give better results. Ploughing the soil more than once before sowing has been known to give better yields as the result of better tilth obtained. This can also be accomplished to a certain extent by including some deep rooted crops like *arhar* (*Cajanus indicus*) and cotton in the mixtures with cereals or crops like potatoes and ground-nut in the rotation; because in harvesting all these crops, the soil is stirred much more than in harvesting cereals or oil-seeds.

Subsoiling has proved of value in other countries and may prove useful in certain places in India; but there are not sufficient accurate experimental data to go upon.

As the cost of such methods against that of the existing ones has not been properly worked out we would advise caution before recommending them to the cultivators.

QUESTION 13.—CROP PROTECTION, INTERNAL AND EXTERNAL.—(*i*) Fumigation of seeds and plants and other imported articles like cotton bales likely to bring insects and fungoid diseases is being done at present at ports of entry and is likely to prove useful, but we have not yet got sufficient data to say whether they are efficient in producing the desired effect.

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(ii) The methods adopted internally for protection of crops against pests and diseases at times prove efficient while sometimes they are only partly successful. Although pests and diseases have been studied by different specialists, opinion has been expressed by others that diseases are mere symptoms of physiological trouble or some other physical factors and the fact that the measures suggested by specialists are not as specific as in the case of human diseases, lends support to the latter view. In any case general scientific opinion is veering round to the view that the real cure for the diseases and posts would be to find out disease-resisting varieties and extend their use.

While this measure of combating the diseases may be resorted to, the study of the diseases and pests need not be neglected. In fact a further intensive study is necessary in order to search for possible remedies for the more important diseases and pests. When the diseases or pests occur in large tracts, attempts of individual cultivators will not prove as effective as they would be if undertaken in co-operation by all the cultivators over the infected tract. Dissemination of knowledge regarding the pests, their life-history and methods of control and fostering a spirit of co-operation is necessary for the measures to be adopted to be crowned with success.

QUESTION 14.—IMPLEMENTS.—(a) An examination of implements used by agriculturists for their mechanical and economic efficiency by the officers of the Agricultural Departments would bring to light the exact defects of the implements that require improvement. It would be apparent to any one that the implements to be recommended to the average Indian cultivator possessing a small holding would be different from those required by the big landholder. The big landholder having large areas to cultivate in one place would naturally require machinery designed to dispense with a large number of unskilled manual labourers. He can also afford to invest some money in costly machinery which is meant to save him part of the payment of wages. Such landholders cultivating the land on their own account are very few in India at present and the ordinary agriculturist is not in a position to go in for such costly machinery nor is his holding sufficiently large to allow an economic use of it. Hence for the present and for a long time to come there is a great necessity for improving the present implements drawn by bullocks or other animals. This improvement can be brought about by the agricultural officers finding out what is wanted for a particular implement to be effective and when this is known to offer prizes to local mechanics by asking for small models of implements including the new features desired. Thus some years back a prize of Rs. 500 for a seed drill was offered by Dr. Mann from his private funds. We do not see why a similar attempt cannot be made by the Agricultural Department whenever the necessity arises. The prizes need not be high, nor will it be necessary to have all the features in one model. The prize may be divided according to the new features introduced, but it would be possible by combining all the features of several models to prepare a new model if the Agricultural Engineer and his staff and the competing mechanics work out the problem.

(b) Such improved implements or others of a similar type obtainable from manufacturers at a price within the means of the cultivator should be demonstrated in villages for a few seasons and if they prove successful the cultivator would be naturally induced to buy them.

In the case of complicated machinery a stock of spare parts at one central place in a district would be useful.

(c) If the manufacturers seek the help of the Agricultural Department in finding out the exact requirements of the cultivators with regard to the machine they wish to manufacture, or the defects of the machine which they have already put on the markets and if this help is freely given, the manufacturers would be able to produce a more suitable machine than if they were to depend on their own resources. Arrangements for testing such machines could be made by means of competitive trials. The holding of such trials need not be expensive as the advice of the department is free, the cost of working the machines in the trials should be borne by the manufacturers. The holding of such trials would give the manufacturers and the officers of the department an idea as to how the different implements could be further developed.

QUESTION 15.—VETERINARY.—(*a*) The Association looking at this question from the agriculturist's point of view would suggest that the agriculturist, if he is to be asked to seek help, advice and encouragement, it should be from one department instead of many; hence we would urge upon the attention of the Commission the desirability of bringing as many allied subjects under one department as possible rather than divide them into water-tight compartments. There may be separate branches of an Agricultural Department but for administrative purposes they should be under one head. There appears to be no valid reason to select the branch of animal pathology or veterinary science for separation. Just as the agriculturist is likely to require the services of a plant pathologist or a plant breeder, so also he as a keeper of livestock is likely to require the services of an animal pathologist and a stock breeder and the Association sees no reason why the Veterinary Service should not be under an Agricultural Department. If both these departments are combined, an economy is likely to result in supervising staff.

(*b*) The agriculturist in general is hardly aware that there are veterinary dispensaries and that he can use them. Only a few people near the towns, especially the drivers of hackney carriages or *tongas* and those who keep highly priced animals go to such dispensaries for treatment where probably they have to make a payment. In the absence of the very knowledge of existence of such dispensaries the demand for expansion can hardly arise. Officers of the Agricultural Department should make these dispensaries known to the agriculturists and get the assistance of veterinary doctors to affected areas coming under their notice.

(*c*) Agriculturists are not making much use of the veterinary dispensaries; they seek aid from persons who know some empirical remedies. It is necessary for the Veterinary Department officers to study these indigenous remedies and how far they are likely to be effective in every-day practice. The system of indigenous medicines may not have any theory behind them but the effectiveness of the medicines themselves suggests that an enquiry into the efficacy of the indigenous drugs is called for.

(*d*) Insufficient number of veterinary men and dispensaries and lack of cold storage rooms for vaccines and sera at suitable centres are handicaps in dealing with contagious diseases. Legislation for segregation and disposal of diseased carcasses is advisable. There is some difficulty in securing serum when required to meet the demand. It sometimes arrives late when the necessity for it has disappeared.

(*f*) (1) Want of confidence on the part of the ryot in the treatment and (2) religious scruples prevent him from resorting to inoculation of his animals. The majority of ryots are also ignorant of the necessity of precautionary measures like inoculation done by the Central Veterinary Department. A certain amount of propaganda would be necessary before the ryots realise the value and necessity of inoculation and other precautionary measures.

(*g*) Better facilities for research in animal diseases are desirable in Provinces. There should also be central depôts for sera in each Province so that the latter will be within easy reach of the district veterinary men. Until the provincial research centres develop, the Muktesar Institute should continue its investigations and when necessary should collaborate with the provincial research institutes by giving them such help in trained men as may be required.

(*i*) Unless the Veterinary Department is to be separated completely from the Agricultural Department no case is made out for a superior veterinary officer with the Government of India.

QUESTION 16.—ANIMAL HUSBANDRY.—(*a*) The work done on breeding livestock is limited to breeding cattle only. Opinion is divided as to whether cross-breeding (introduction of foreign blood) should be resorted to or the indigenous breeds of animals should be developed as pure breeds or by judicious cross-breeding among different Indian breeds. Cross-breeding (country cows × foreign bulls) has certainly given in the first generation cows giving a high yield of milk; but in the second generation these cross-bred animals have failed to give a progeny of high yielders. The cross-bred bulls have not proved strong for draught purposes. Moreover cross-bred animals are more subject to certain diseases than the country-bred animals. The cross-bred cows of the first generation are useful for the urban dairyman. The Indian cattle could be bred up into good dual purpose animals by selective breeding and judicious feeding. It may be a somewhat lengthy process but better suited to the Indian conditions. At present the agriculturist has two kinds of animals, the cow and the buffalo. It is little use substituting a cross-bred cow for the buffalo. Very little attention has been directed to breeding the buffalo as the he-buffalo is not a good draught animal; but attempts could be made to develop the buffalo in this direction.

Distribution of good breeding bulls for the use of ryots is a necessity which if supplied at a nominal cost will be greatly appreciated in certain parts of India. Breeding bulls should in the first place be supplied where none are available at present. In this connection it is better to point out to the ryots that if castration of bulls other than the breeding bull is not carried out the object of keeping breeding bulls is likely to be defeated on account of the resulting promiscuous breeding by other bulls of a bad strain and it is better to (1) restrict the distribution of breeding bulls to areas where the people are willing to carry out this measure and (2) take away the concession already granted from those who are unwilling to do so.

In disposing of the surplus stock at Government institutions, attention may be paid at least sometime to come to distribute the surplus pedigree stock to persons interested in breeding at a reasonable price so as to keep the well-bred animals for the purpose for which they are meant.

(*b*) At present the dairying industry as well as breeding of stock suffers from want of suitable grazing areas. Dry animals suffer comparatively more than milch cattle or working bullocks. These latter are looked after better because they are paying or useful animals while the dry animals are looked upon in the same light as other useless stock, *i.e.*, as a burden on the slender resources of the cultivator.

Availability of cheap fodder including green succulent fodder throughout the year is the key to the breeding of livestock and dairy industry. Pastures or grazing areas in suitable localities and better transport facilities for getting fodder from localities accessible with difficulty at present are therefore considered necessary for encouraging animal husbandry.

If these two requisites, *viz.*, cheap fodder and a pedigree bull, are supplied the agriculturists will naturally pay more attention to animal breeding and will be able to have better animals.

(*c*) The possibility of growing green fodder in dry months requires to be examined. Low-lying lands near rivers where irrigation is possible, require to be exploited much more than at present.

For the purpose of improving cattle, attention should therefore be first directed to increasing the supply of both green and dry fodder where it is scarce and to discovering possibilities of extension of growth of fodder in areas where intensive cultivation is carried on.

QUESTION 17.—AGRICULTURAL INDUSTRIES.—(*a*) The number of days that a cultivator has work in his holding varies in different parts of India. In the irrigated tracts the idle days are very few and there is no slack season as such and the extension of irrigation advocated would therefore prove effective in reducing the slack season in tracts that would be served by the canals. Facilities for digging wells in dry areas and in those parts where canals cannot be extended would have the effect of ameliorating the condition of the agriculturists. In dry unirrigated tracts the number of idle days varies from 80 to 120 in the year. The period of idle days is not always continuous. In the slack season the agriculturist goes as a day labourer in his village or migrates to towns for the same purpose; sometimes he effects new improvements in his field such as *bunding;* otherwise he has nothing to do. The agriculturist will have to be given education in the particular vocation recommended for him with the necessary means to purchase the outfit for starting the industry.

(*b*) In the dairy tracts manufacture of products such as casein, milk powder, crude lactose, condensed milk, etc., may be suggested at present where it is not possible to export whole milk to cities. Butter or *ghi* is exported to large cities like Bombay or Calcutta but the whey is not utilised and sometimes actually wasted. In the fruit and vegetable growing areas there are seasons of plenty and scarcity. In seasons of plenty, fruits and vegetables from these places are sometimes dumped in towns and cities where they do not fetch the price they would if the supply were regulated and sometimes they are sold even at a loss. Preservation of these by canning or turning them into jams, jellies or pickles and preserves by drying is to be recommended. At present the advocacy of these has been taken up by chemists and horticulturists but not in a serious manner with reference to particular tracts.

If a persistent attempt is made by forming village clubs or co-operative societies where possible, the Association is of opinion that these two industries are capable of considerable expansion and likely to find daily employment for many people in these tracts. Preservation of fish by canning, smoking or drying is another industry that can be encouraged in coastal districts where also extraction of fish oil is likely to stimulate agriculture by production of more fish manure.

In the cotton growing parts of India where home spinning of cotton and weaving used to be done by the whole family when not actually employed in fields, these occupations can be encouraged by supplying better handlooms and by arranging for sale of the produce in special shops where articles of home industry would be sold. These might be co-operative stores or institutes who might depute their men to collect from each family the work turned out by them during the whole day.

In localities where silkworm rearing caste or class already exists, sericulture can be extended as a cottage industry to provide work in slack season or at other times as well, to members of the agriculturists' family who by reason of old age or *purdah* cannot earn wages as day-labourers, but this will be successful under the following conditions:—

(1) If the District Boards are prepared to plant mulberry trees on roadsides and let them out on nominal charges to deserving cultivators; (2) the Industries Department or co-operative societies are prepared to purchase even small lots of cocoons from the growers; (3) existence of filatures for sericulture as an independent industry in the neighbourhood; and (4) starting of more nurseries to supply disease-free eggs.

It has been found that sericulture is not likely to be taken up in earnest, in areas not hitherto known to produce silk, as people are averse to handling the worms.

In the Punjab and Kashmir where sericulture is carried on, the disease-free silkworm eggs are imported from Europe. Efforts should be made to produce locally disease-free eggs for distribution and rearing in India. This will save a large amount of expenditure which is incurred annually on the supply of imported eggs.

Eri silk culture is eminently fitted to be introduced as a cottage industry even in new areas as no life killing of the insects is needed in any of the stages and castor plant being a seed crop, a profitable use of the leaves can be made.

Lac culture also deserves encouragement not only in the districts where it is an existing industry but also in new districts where *palas* (*Butea frondosa*)

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and *babul* (*Acacia arabica*) grow and favourable climatic conditions for the propagation of the lac insect exist. To popularise this industry and to demonstrate to the people economic methods of lac culture trained fieldmen from entomological sections in the Provinces should be sent as often as necessary.

(*c*) Bee-keeping is not at present being carried on as a regular industry. Owing to crude methods of extraction, country honey is generally very impure and therefore sells at a much cheaper rate than the imported honey.

Experiments were started in 1909 at Pusa to see if European honey bees could be successfully kept in the plains of India in modern hives. For this purpose bees were imported from England but they did not flourish. The artificial multiplication of queen bees could not be a success on account of the prevalence of bee-eaters (*Merops*). The importation of fertilised bees from Europe by post is not economical. At present importation of hives from outside India is fraught with danger on account of honey-bee-diseases which are prevalent throughout Europe. Bee-keeping on modern lines is being carried on in the hills with the indigenous species. But they yield a much smaller quantity of honey than the foreign species.

High class Hindu castes have religious objections to taking up poultry rearing. Mahommedans, Christians and low class Hindus keep poultry. Private associations are doing good work by holding shows, etc., but we believe the Agricultural Departments in the Provinces can also do useful work in this line. At present there is an absence of proper marketing facilities in villages and poultry-keepers do not reap the full benefit from this industry.

Fruit growing as a subsidiary industry is being carried on at present in the plains wherever irrigation facilities from wells or canals are available but the obstacles to further expansion of the industry in cooler parts of India and in the hills are:—(1) their great distance from the consuming centres, (2) slow transport from the hills to the railway stations, and (3) the loss of fruit in transit due to pilfering on the railways.

(*d*) Oil pressing factories exist in the tracts where oil-seeds are largely grown, but the market for oil and oil-cakes in India is limited. Much propaganda work is required for the better utilisation of oil-cakes internally for feeding to cattle and for manurial purposes as their export means continuous depletion of the fertility of Indian soils.

(*e*) Subsidiary employment can be found by encouraging industrial concerns to be located in rural areas but this is feasible in the case of those articles which are manufactured for local consumption, as otherwise their transport to places of export would add to their cost.

Further the industrial concerns located in the villages will have to be such as have to depend upon bulky stuff for their raw material such as sugarcane which cannot be transported long distances by rail because of freight charges and of deterioration in transit. Opening of more sugar factories in rural areas will provide more employment for the idle labour in the villages and also for cart traffic.

(*f*) There are so many occupations carried on in villages such as those of carpentry, smithy, pottery, shoe-making where an intensive study of local practices and improved methods employed in Western countries in small village establishments will enable improvements to be effected in the inefficient tools and appliances at present used in India. The outturn of these workers in Indian villages is far short of what they can do with greater facilities and in this connection the Association would recommend the establishment of such craft schools on a modest scale in each taluk, half the cost being met by the Government and other half by the taluk as a whole.

(*g*) The Association believes that there are more men on the land than are required for agricultural work; hence arises much of the trouble. Emigration would partly alleviate this. Making the dwellers in villages to yearn for a higher standard of life will in due course make them work more and prevent them from wasting their hard earned money in drink, litigation and useless social expenses. This will come on with the spread of education among them and hence the Association would recommend compulsory education wherever possible.

(*h*) More propaganda work on the part of the Sanitary and Health Department is required to make the villagers realise the dangers from infectious diseases, to acquaint them with causes of the spread of malaria, plague, small-pox, hookworm and such other diseases. By lantern slide demonstrations and other means the causes and progress of the disease may be shown to them and how these can be prevented or kept under control by precautions on their part. The use of dirty water for drinking and bathing, washing of dirty clothing at the drinking water wells are mostly the result of ignorance on the part of the villagers as to the serious consequences which flow from them. In this connection the Association would again urge that every village should have as far as possible its own co-operative society, its own village school with a small plot attached to it and a small library. Those who have been through the school would be enabled to keep up their education. They would work more easily together in combination with a view to improve their condition and they would readily listen to the advice given by itinerent staff of the Agricultural, Veterinary, Co-operative and Sanitary Departments. Development of private associations on the lines of social service leagues will go a long way in ameliorating rural health.

QUESTION 18.—AGRICULTURAL LABOUR.—(*a*) The Association understands that on the continent of Europe there used to be in pre-War days a Home Colonisation Office which used to work with a view to assist emigration from a congested area to an area sparsely populated so as to bring about a normal supply of both agricultural labour and cultivation of land which used to previously remain fallow. There is room in this country for such an organisation as we have got in India tracts where the density of population is over a thousand per square mile while there are tracts like parts of the Central Provinces, Central India, Assam and Burma, where there is a real shortage of both agricultural labour and cultivators to till the soil. When inducing the rural population from a congested area to emigrate to sparsely populated area, it should be explained to them that the land proposed to be given to them will be large enough to support a family and that they will be charged 3 per cent interest on the value of the land for 60 years, at the end of which period they would own the land in fee simple as is done for the landless in Ireland.

QUESTION 20.—MARKETING.—(*a*) In connection with market facilities for sale of produce the Association would consider the establishment of properly conducted sale depôts to be highly desirable so that the cultivators may not have to part with their produce at any low price which may be offered to them. There should be posted upon the notice boards current market rates for that particular produce as received from important centres of trade so that the cultivators may compare the price which is being offered to them and if not satisfied with the price may keep their produce in the godown of the depôt for sale when better price is offered. These markets will be particularly of use in case of non-food crops such as cotton, ground-nut, etc.; some such system was proposed to be organised by Lord Kitchener when he was High Commissioner in Egypt where the Fellahi were to be kept informed of the prices of Egyptian cotton ruling in the Liverpool market, whereby they were to be enabled to make better terms with the purchasers of such cottons. The Association understands that much good work has been done in Berar by the institution of cotton markets and the Association would like to see the extension of such markets in other cotton growing tracts where conditions permit of their being established.

The agricultural produce when it leaves the cultivator's hands generally passes into the hands of a *mahajan* or middleman, thence into the hands of an agent of an exporting firm in Bombay, Karachi, Calcutta, etc., and finally the exporting firm transports it by sea to foreign countries. Very often the cultivator is either in debt to the *mahajan* or has taken an advance from him or has sold his crop ahead, whereby he is unable to reap the full advantage of the fluctuation in prices brought about by the world factors. He has therefore very little inducement to grow crops pure or of better quality and hence while inducing cultivators to grow crops of improved variety or of better yielding power it is necessary to devise means whereby they may be enabled to sell their produce at its superior value.

(*c*) Indian produce abroad has generally a bad name for impurity, mixing up and low quality. Steps therefore should be taken to make an improvement in this matter. Some mixing up of sand, dirt, etc., takes place on the cultivator's own threshing floor where he gets his corn trodden out by bullocks and some mixing up is also inevitable in those parts where the practice of growing mixed crops is in vogue. Some mixing or adulteration must be taking place in the case of non-food crops at the hands of middlemen and other intermediaries.

The Association considers that cultivators as well as small merchants outside the main ports in India are not sufficiently acquainted with the prices of the produce ruling in other markets of the world, the fluctuations therein and the causes thereof. What is required is that each trade should have a regular service for getting telegraphic information from the important foreign markets, the condition of the crop dealt in, stocks and consumption. By combining together each trade can get for its own individual members up-to-date information at a cost which would be prohibitive for a single individual. Greater publicity should also be afforded in district towns and other important places by issuing market bulletins in vernacular either through the local newspapers or by the association of the merchants and traders themselves. As India is no longer cut off from the rest of the world and as prices are fixed for all important export crops in centres outside India, it is of the utmost importance to devise measures to keep the trade and through it the agriculturists well posted in the prices of the important commodities, because the difference between the price the cultivator gets and the price which he should have got makes all the difference to him between the success or the failure of that crop from the point of view of economic production.

(*d*) In the opinion of the Association it is high time that the Central Government should establish a marketing bureau on the lines of the United States, of America, (1) to gather and disseminate information concerning supply, demand, prevailing prices, (2) to promote, assist and encourage the organisation and operation of co-operative and other associations and organisations for improving relations and services among producers, distributors and consumers, (3) to foster and encourage standardising, storage and sale of agricultural products, (4) to investigate the practices and methods and any transactions of commission merchants and others who receive, solicit and handle on commission any such products and to protect and conserve the interests of the producer and the consumer, (5) to improve, broaden and extend in every practicable way distribution and sale of agricultural products and (6) to reduce the expense and cost of marketing.

QUESTION 21.—TARIFF AND SEA FREIGHTS.—So far as raw material is concerned, there is nothing to complain about the existing customs duties. Export duties are only levied on jute, which is the monopoly of Bengal, Bihar and Assam and on rice exported from Burma which occupies a considerable position in the rice trade. The tea, lac and the cotton industries impose a small cess which is intended for the benefit of the industry as such and therefore does not come within our purview.

QUESTION 22.—CO-OPERATION.—(*a*) In Provinces which are more advanced than others non-official agencies are being more and more interested in the progress of the co-operative movement and by affording facilities for acquiring some knowledge in the principles of co-operation through co-operative institutions and other means an increasing body of unpaid workers is being brought in. Useful work is also being done by some members of the Servants of India Society. The services of Mr. G. K. Devdhar in this connection may be specially mentioned. In those tracts in which the rural population is very backward, the Government should do more in first preparing the ground by educating the people in the principles of co-operation and starting societies where people evince their desire to have them. In the first stages considerable assistance should be given to such societies by giving them the services of a trained secretary and by paying frequent visits to the societies to see how they are working. It is only when the department is satisfied that these societies can stand on their own legs that official assistance should be withdrawn.

(*b*) (*ii*) Co-operative purchase societies are very useful for such things as manures, seeds, and implements as the society can obtain them at cheaper rates by ordering in bulk and by being able to make cash payments. It may be mentioned that unless the members of the society have some sort of business instinct they are likely to be unsuccessful, *e.g.*, whether artificial and other manures should be purchased at a time when the prices are low and stored or whether they should be purchased just before they are required when usually the price is high.

(*iii*) Co-operative sale societies are more difficult to manage as they usually come into open competition with vested interests. Here also business knowledge is required as a large quantity of produce has to be dealt with and the best possible price obtained for the members. To enable co-operative sale societies to function successfully, proper facilities for marketing are essential and here we would repeat that intelligence about current market rates within the country as well as abroad should be available to them. Co-operative societies are useful in another way in that the members would not be cheated in weights and measures nor will they be obliged to sell at whatever price is offered them by the ring of brokers or middlemen or some such other intermediary. A co-operative sale society can hold its produce for a rise in the market and can thus ensure full benefit to its members. The Agricultural and Co-operative Departments should have a staff who by frequent visits will render them such assistance as may be required. The Association would welcome whatever measures the Commission recommend for the extension of this form of co-operative movement. It is inevitable that mistakes will be made; some attempts may prove failures, but in view of the great utility of this side of the co-operative activity it is desirable not to lose heart but it should spur the Co-operative Department and those who have faith in the co-operative movement to redouble their efforts and to spread its blessings among the rural population.

(*vi*) A society for the co-operative use of agricultural machinery would be of great assistance to sugarcane growers as they can purchase power cane crushing plants which are beyond the means of ordinary agriculturists and are highly necessary in order to extract the amount of juice which is at present wasted by the prevalent method of crushing cane by bullock-driven two-roller or three-roller mills. Such societies can also purchase costly implements, *e.g.*, those for eradicating *Kans* grass and make them available for the use of individual members.

QUESTION 23.—GENERAL EDUCATION.—(*a*) In the modern world to be able to read and write has become almost a necessity for any individual in any walk of life and the agriculturist cannot be an exception to the rule. To him knowledge of arithmetic is equally essential. The efficiency of an illiterate agriculturist already well trained in his occupation may not be less than that of a literate one but if he wishes to be abreast of the time he must keep himself informed of the advances that are being made. It is in this respect that the literate agriculturist scores over the illiterate one; and hence we find that those countries in which the agriculturists are literate are advancing in various directions. In his every-day dealings with the middleman we find that the agriculturist in this country is cheated in many ways by short weights and false measures. He very often does not know the price ruling in places where his produce is finally sold. He is unable to calculate therefore the fair price that he ought to get for his produce.

It is for these considerations that the Association thinks that primary education should be made compulsory.

As regards higher education, literary education specially in its higher branches is more in fashion probably because at present there is not sufficient provision for other kinds of education available. It would be a move in the right direction if the middle school and high school education were much more varied like higher collegiate education. At present there are colleges for medicine and surgery, mechanical and civil engineering, agriculture, and for military training, but in high schools we find only one literary course without any attempt at imparting instruction in any vocation. The Association would therefore advocate the opening of technical schools in which the village industries would be dealt with and modern appliances and improved tools and improved methods of working in, say, carpentry, smithy, pottery, or leather manufacture and hand spinning and weaving be brought to the notice of boys attending middle schools so that when a boy leaves the school he will be able to set up as an independent working man instead of having to seek service on the merits of his literary ability as at present. It would be quite feasible to start one technical school on the lines suggested in each district. These technical schools can manufacture articles which will find a ready sale if they are adapted and suited to the needs of the people. Part of the money realised in this way may be credited to the account of the boys working in them so that at the end of the term the boys will have not only confidence in themselves but the money wherewith to buy the things required for starting the industries.

(*b*) (*i*) To give a varied character to the education given and to introduce the study of natural sciences along with literary subjects will turn out people better fitted to make a living and also create interest in agriculture. In order that craftsmen may be induced to follow their ancestral trade with intelligence, a training in manual arts may be introduced in suitable localities if not in all places.

(*ii*) Compulsory education, though desirable in rural areas, should be preceded by free primary education in villages to induce cultivators to send their sons to schools. Otherwise as a majority of them require their sons to tend to their cattle while grazing or do some light work for the household, they will be unwilling to send their sons to school as they themselves hardly appreciate the benefits of such education.

(*iii*) As soon as the boys attain a certain age they begin to be useful to their parents in their work. It will be a burden on the slender resources of the parents if boys are sent to schools when they cannot afford to lose the income which the boys would be able to earn and if fees have to be paid in addition there will be still less inducement. In this connection it may be pointed out that the fees in primary schools in certain parts of India specially the ryotwari districts are lower than in zamindari tracts and Provinces. The Association therefore suggests that (where the value of land has much increased since the time of permanent settlement) moral pressure be brought to bear on the zamindar to open schools for the sons of his tenants like the Indian millowners who are now beginning to do welfare work for their labourers by opening schools for their sons and giving medical aid in certain cases. As the zamindar is getting rich on account of the permanent settlement through people toiling in his fields, it is but natural to expect that he should be asked to pay a certain sum as contribution for maintaining a free primary school for his tenants' sons and for other activities likely to improve rural conditions.

QUESTION 24.—ATTRACTING CAPITAL.—(*a*) Agriculture by itself as carried on now is not profitable and men with capital do not invest money in it because as an industry it does not yield as much interest as is obtained in other industries. Agriculture at present is reduced to the state of industry in which the cultivator employs his daily labour to earn some days' wages during the year; and hence unless the size of one big farm or the total number of holdings is sufficiently large to be economically productive and at the same time capable of providing a decent living, no man of capital will be attracted to agriculture. The passing of such Acts as the Usurious Loans Act and the Deccan Agriculturists' Relief Act has made the man who can lend money to the cultivators shy of investing his capital in land mortgage made even for improvements in lands, as there is in his view no surety of getting due interest and sometimes even the capital is lost. If the capitalist takes to agriculture on his own account, it is but natural that he would expect to have some if not all amenities of life that he enjoys in cities and towns, a better social organisation, the lack of which drives away people of means to towns.

(*b*) The financial condition of the agriculturist is certainly not such as will permit of his effecting improvement in his land. Lack of capital makes the agriculturist hesitate to borrow money for costly improvement because if the undertaking proves a failure for some reason or other or does not yield a good return, the agriculturist is burdened with unproductive debt. A short-term lease and uncertainty of tenure in zamindari lands is another factor which naturally discourages actual cultivators from effecting improvements. There is also the fear and suspicion lurking in the minds of the agriculturists that any improvement effected by them would be liable to increased land revenue. In zamindari tracts the increase in rent would be much higher. The local customs of zamindars designed to evict a tenant by increase in rent or participating in the benefits of improvement without paying for it also act as deterrents. In some cases ignorance of the fact that any improvement is possible is also responsible for non-improvement or stagnation.

Want of enthusiasm and co-operation among fellow cultivators are also partly responsible. Provision of adequate propaganda staff of agricultural organisers and demonstrations of improvements in villagers' plots are means to make the agriculturist effect improvements in his land.

The Association considers that in Northern India where the zamindari system prevails the zamindars should be made to devote a portion of the money which they derive as rent collected from the tenants in starting demonstration farms, seed stores, implements depôts, veterinary hospitals and in supplying good bulls for improving the breed of cattle. In the past when zamindars like petty kings used to protect the people by maintaining a small army of their own it was fair that they should exact the land tax from those who owed security of their lands and crops to the protection offered by them, but now they no longer fulfil the function and for the rents charged at present no substantial service, it appears, is being rendered to the tenants and this seems inequitable so long as this state of things continues. If we are to have better social organisation, panchayats or Union Boards should be encouraged wherever possible. Demonstrations of what a model village should be like may be given by establishing one such village in each taluk as it is the surest means of making the people in towns as well as in villages realise that life in villages of which the model villages are examples is worth living. Retired engineers, medical men and officers of the Agricultural Department may be induced to stay in villages by giving them certain facilities and a seat on the Union Board or panchayat. This will give an impetus to the development of model villages. In colonisation schemes also a sprinkling of such men amongst the agricultural colonists is necessary as it would thereby naturally make the people in such colonies pay more attention to health and hygiene and better transportation facilities in a way that no amount of lecturing would do.

QUESTION 25.—WELFARE OF RURAL POPULATION.—(*a*) The Association would consider that the improvement in the rural conditions will be to some extent accelerated if in each taluk one or two model villages are brought into being. By a model village the Association means a village which has got a hospital, a village school, a co-operative society, an agricultural association, a veterinary dispensary, a small library and a place of amusement. Such model villages should be connected by good *pucca* roads with headquarters of the taluk. The cultivators round about might be induced to visit these model villages frequently. Thereby an interest will be aroused in them to improve their own village conditions and unless sanitary and social conditions in villages are made better than what they are at present the present drift to the towns will continue. In the past when the mode of life was practically the same for rich and poor alike, the villages were more homogeneous but now that towns and cities provide so many facilities and comforts of life, those who have wealth are tempted to migrate more and more to cities where they can command the highest class of education for their sons and daughters and can have them settled in various avocations of life. A great field is opened out in the commercial and industrial lines in cities and human instinct being what it is, everybody thinks that he can better his prospects where any one whom he knew has actually done so.

(*b*) The Association is in favour of Government conducting economic surveys in typical villages with a view to ascertain the economic position of the cultivators. In this connection the Association is in general agreement with the views of Mr. Burnett Hurst in the Economic Enquiry Committee.

QUESTION 26.—STATISTICS.—(*a*) At present the departments in the Provinces issue Season and Crop Reports and Forecasts of principal crops. It would be desirable to have these as widely advertised as possible in the mofussil also so that an idea may be formed of the stocks likely to be available in the coming season and the prices may be regulated more on such established information. As regards estimates of crop yield these are based on the area under a crop, the average yield per acre and the seasonal factor. As regards area figures these are fairly accurate in ryotwari tracts and in those places where land records are properly maintained. In certain zamindari tracts in Madras and in the permanently settled tracts in Bengal and Bihar they are capable of improvement on similar lines as ryotwari tracts. As regards the average yield per acre the Agricultural Department should conduct more crop cutting experiments in different types of soil so that a fairly accurate figure may be arrived at. As regards the seasonal factor it would be better to give in percentage, the weather conditions influencing growth of the crops as compared with the average of the preceding ten years instead of saying that it is ten or twelve annas of the normal crop as nobody is sure of what quantity is exactly meant by a normal crop. It is desirable that in each Province there should be a bureau of statistics attached to the Agricultural Department with a good staff at the headquarters and with itinerant assistants who would go round in the district checking the returns submitted by the revenue authorities and educating them when necessary as regards the value of accurate figures. In advanced tracts some non-officials living in villages and in touch with agriculture may also be tried as reporters for the purpose of forecasts as an additional check on the returns, submitted by the Revenue Department.

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Oral Evidence.

A.2602. *The Chairman:* Mr. Joshi, you are Secretary of the Pusa Association of the Imperial Agricultural Department; is that the title?—Yes. At present I am officiating for the Secretary, who has gone on leave.

A.2603. We have in our hands the note of the evidence that you wish to give. Have you any further statements that you would like to make at this stage, or shall I ask you one or two questions?—I would only like to say this, that we have in several meetings of the Association discussed all the points that we have noted down in our memorandum. The memorandum was drawn up by a committee appointed for the purpose and it has been read out and discussed in the meetings of the Association. This memorandum, therefore, represents the collective opinion of the Association.

A.2604. How long has the Association been in existence?—For nearly two years.

A.2605. Your note is very full, and I think, your meaning is perfectly plain on the face of it, but there are one or two points I should like to ask you about. Would you turn to page 293? You are talking there about publications and you say, "The delay in publication of the results obtained by research workers in the various Departments of Agriculture in India hampers to a great extent the progress of research." To what exactly do you attribute that delay?—The delay occurs in getting the results printed. They have to be circulated to several members of the staff who are sometimes on tour. We have got to wait for them for one or two months, and the time taken in printing is also considerable.

A.2606. You would probably agree that a certain amount of delay on occasions is less disadvantageous than would be the premature publication of unsound results or anything of that sort?—That is true in some cases, but in other cases it is a disadvantage, because the results that we have already obtained are sometimes printed in other countries before our publication is out.

A.2607. So that you think that a Board of Editors might take the responsibility? Is that the point?—If the printing could be done a little quicker, it would be a great advantage.

A.2608. Is it the Head of the section concerned who goes away on tour or who? I am not sure that I have understood you?—After the Head of the section has passed it, it has got to be circulated.

A.2609. To other Heads of sections?—Yes, and they are sometimes on tour.

A.2610. I see you are not satisfied with the indexing in the library?—That is so.

A.2611. Has there been any improvement in that respect of late?—We have not got the index of subjects or of the journals that is to be found in the United States of America.

A.2612. Is it the experience of members that considerable delay occurs in searching for particular books?—Yes.

A.2613. Turning to page 293, have you anything more to say about post-graduate training than what is set down therein? Can you suggest any means by which this course might be made more attractive?—After putting down our views in the memorandum, I have been told that some of the Heads of sections are quite willing to take students for the higher degree given by the Indian Universities provided there are seats available. If this definition of their attitude is made clear when advertisement is made for admitting students in the Institute, perhaps it would attract more applications.

A.2614. I want to be certain what it is that you mean when on page 294 you suggest the institution of an Agricultural Organisers' Service? Are you thinking there of a series of organisers in Provincial Services?—We are talking of an Agricultural Organisers' Service in the Provinces.

A.2615. What exactly do you mean on page 295 when you speak about the lack of comradeship in the laboratory?—We mean that at present we have got three different services in this Institute and there is a large difference in the pay and prospects of these services. This creates a feeling among the different members of the staff which leads to the members of one service feeling rather diffident about approaching the members of the higher service simply because they think that the administrative differences that exist would prevent them from consulting them in the same manner as they would have consulted men in the same service or men who had risen from the same service.

A.2616. I understand what you hold to be the circumstances that bring about this lack of comradeship, but in what fashion does it manifest itself? Is it a question of subordinates not being taken into the confidence of superiors about particular experiments or what? Is that one phase of the matter?—The Heads of sections, for example, come in contact with each other and meet each other at various times and the scheme for experiments that they lay down is perhaps passed on to the subordinates in the various aspects. The subordinates do not know the scheme as a whole and therefore they do not take the same interest as the Heads of sections do or which they would take if they were present at the time of consultation. Hence their interest in carrying out the experiments is not the same as it would have been if they were present when the original experiments were agreed on.

A.2617. I was a little surprised to notice that on page 297 in suggesting that farms should be attached to certain educational establishments, you name 100 to 200 acres. Is not that rather a large farm?—This farm is supposed to be attached to the high school of a district where the number of students is expected to be sufficiently large.

A.2618. I am sure you and your associates appreciate the difficulty of managing a plot of that size. It becomes a very big unit and requires skilled management?—We would like to have a trained agricultural graduate for that purpose.

A.2619. You suggest that the Agricultural Department itself should manage the farm; is that the idea?—No, the trained agricultural graduate should be in the service of the Education Department.

A.2620. I am not misinterpreting your words. On page 297 you are talking about training students in high schools and you say that it will be necessary to maintain a farm of 100 to 200 acres managed by the Agricultural Department?—I am afraid in the hurry of getting up this memorandum, this mistake has occurred. It is a mistake to say that it should be managed by the Agricultural Department as such; it should be managed by agricultural graduates.

A.2621. On page 298, you develop your ideas for the extension of the demonstration and propaganda services, and I see that you are attracted by the suggestion that the grouping of panchayats should be encouraged by way of stimulating self-help?—Yes.

A.2622. Do you know of any actual experiment upon which this suggestion has been founded?—There has been some movement in these panchayats and Union Boards in Bengal to have this sort of thing done. In other Provinces there are not many panchayats encouraged like that as yet. The panchayats are not formed, or where they are formed they have not had sufficient time. We think that these panchayats, if they are formed, will take this up.

A.2623. On page 306, you are dealing with veterinary problems. I take it you have no representatives of veterinary science on your Association?—We have.

A.2624. Do they subscribe to the view that it might be well to make further investigations into indigenous remedies?—Yes, they do.

A.2625. On page 314, I have studied your suggestions for the creation of model villages for propaganda purposes. I do not quite gather from your scheme how these works are to be financed. Where do you suggest the money should come from for the creation of a model village in each taluk?—In the first instance, for the one or two model villages that may be created in a Presidency, this money would come from Government funds. After seeing the model village and its advantages, we think the people from different villages would come forward to get their villages organised, and they would probably be willing to pay the necessary expenses required to remodel or reconstruct their villages.

A.2626. *Sir Henry Lawrence:* Were you in the Bombay Department of Agriculture at one time?—Yes, I was there for 2 years.

A.2627. Do you come from the Poona Agricultural College?—I was trained in the agricultural branch of the Science College. The Poona Agricultural College was not started when I entered college, but I was demonstrator there, under Dr. Mann, for 2 years in chemistry and geology.

A.2628. In the Department of Agriculture at Bombay?—Yes.

A.2629. And then you were transferred here?—Yes.

A.2630. What work are you doing now?—I am First Assistant to the Imperial Bacteriologist.

A.2631. On page 298, I see that you consider that the Bombay system is superior in certain matters. On the question of demonstrations and propaganda, you say, "The measures adopted by the Bombay Department of Agriculture are in the opinion of the Association the most effective ones." Is that your own view, or the view of the whole Association?—It is the view of the whole Association as well as my own view.

A.2632. And you think that when the distribution of seed is made, the department should guarantee the grower against loss?—Yes.

A.2633. Is that being done in any other part of India?—The members of the Association, who come from different parts of India, have not pointed out that it is being done in other Provinces, and in the reports issued by the departments we have not seen any mention made of that system.

A.2634. You think that would be the most effective method; is that based on the experience in Bombay?—We think that guaranteeing the grower against loss not only in cases of seed but in any kind of experiment would create confidence in the grower, and he would be more willing to carry out the experiment than if he had no such security.

A.2635. Do you know whether in fact the Bombay Department has ever had to make good any losses?—We do not think that any substantial loss has occurred except in one or two cases.

A.2636. No claims for losses have been made against the department?—No, except in one or two cases.

A.2637. I suppose it is possible that claims might be made on very unsubstantial grounds, which it would be very difficult to determine?—Of course, in theory, it is quite possible to make such claims, but so far as the practical results of this guaranteeing are known we are not sure whether such claims would be made on flimsy grounds.

A.2638. I gather that you consider that the service which you represent has not got sufficient openings in the matter of prospects and pay. Have you worked out any scheme of what you think would be a suitable scale of pay for yourself and your companions?—We could supply it to the Commission if it is required. We did not like to put it in, because in a general enquiry of this kind we did not wish to put forward our claims as such, as it might be thought we were actuated by selfish motives in representing the claims of our service to a Commission of this kind instead of representing them to Government.

A.2639. Have you made any such claims to Government at any time; have you made any representations on the matter?—We have not yet made one, but we have got a scheme in hand, and we are going to represent the matter.

A.2640. Could you send it in to the Secretary of the Commission for information?—As soon as it is ready I will.

A.2641. When is it likely to be ready?—In a week or a fortnight.

A.2642. That would be ample time. What is the main criticism you have to make? The starting pay is not sufficient, or the pay to which you can rise is not sufficient, or what?—The starting pay is not altogether sufficient. Then after having risen to the maximum pay, the Assistants in the Subordinate Service are not satisfied to remain permanently on that pay. There is no prospect of promotion to the higher service; the posts are limited, and they think that an intermediate grade of pay is necessary for workers who have shown aptitude for research and whose work is appreciated by the department.

A.2643. Are you, in fact, worse off than the officers who remain in the provincial departments?—The Class II officers and scientific Assistants are certainly, in our opinion, worse off than the officers of similar grade in some of the provincial departments.

A.2644. Is there any opening for you to transfer back to provincial department?—The provincial departments are unwilling to take people who have risen in the service at Pusa, simply because the claims of the people serving there are handicapped thereby. They would not like to take men from Pusa except on a lower grade of pay to start with; they would like to promote their own men.

A.2645. Do you wish to see the system of mutual transfer made possible, so that men might be brought from the provincial departments to Pusa and men from Pusa sent back to the provincial departments; is that in the scheme of your Association?—We have not definitely suggested it, but we have discussed it, and if the different Governments are willing to accept that, it would be advisable to do it. But, as we are concerned with the Government of India and we are going to send the scheme to the Government of India, we have not thought it fit to bring the matter of the interchange of officers by the Provincial Governments to the notice of the Government of India, because we have not got the views of the Provincial Governments as to how far they would appreciate it or be willing to give effect to it.

A.2646. You are not reluctant to leave the secure position of service under the Government of India for the more precarious position of service under Provincial Governments? Is that in your mind?—That is not the point; we would be willing to go to the Provinces, but we are not sure that the provincial men would be willing to come here.

A.2647. A system of mutual transfer might be advantageous to both sides, to the Provincial Governments and to Pusa?—I had a discussion about it with Dr. Mann, and he was in favour of it, but we thought it would take rather too long for the Government of India and the Provincial Governments to come to an understanding on this point; it is a question of the various Governments concerned approving of this course, however much we may like it.

When it is a question of having a permanent system, a little delay in considering proposals is not a serious matter; that should not debar you from putting forward the scheme which you think is the best possible for Pusa and the Provincial Departments of Agriculture. I leave it to you to consider.

A.2648. *Sir Ganga Ram:* You are in Government service?—Yes, I am.

A.2649. Is this Association recognised by Government?—Yes.

A.2650. It consists of all the Indian members of the staff here?—It consists of Class II officers, scientific Assistants, fieldmen and other men in subordinate grades.

A.2651. What is Class II?—They are equivalent to the Provincial Service men. The Indian or European members of the Imperial Service are not members of this Association.

A.2652. Is what you have represented here your personal opinion or the opinion of the Association?—This is the opinion of the Association.

A.2653. You placed all these criticisms before your Association before you sent them to us?—Yes. The report of the committee was placed before the general meeting.

A.2654. Have you any personal experience of other Provinces?—Yes, by way of going to the different Provinces and enquiring.

A.2655. You have made some criticisms of Northern India. Have you ever been to Northern India?—Not personally, but we have other members who have been to Northern India.

A.2656. You say on page 314 that the Northern India zamindars should be made to devote a portion of the money to certain objects. How? Do you mean by legislation?—By moral pressure.

A.2657. I do not understand the meaning of moral pressure. What do you mean by that?—By creating public opinion.

A.2658. By starting a political paper?—Something of that sort, if nothing else would make them pay; just as the millowners of Bombay, for example, are doing a certain amount of welfare work for their labourers.

A.2659. Are they doing any welfare work for their labourers? I thought it was the other way. However, what I want to ask you is whether you represent here your own views or whether any other members are in agreement with what you say? You say that in Southern India rivers have been silted up. Which rivers do you mean?—We were given the list by our Southern India members.

A.2660. Have you a branch in Southern India as well?—We have got members representing Southern India, members coming from Southern India.

A.2661. In this Association?—They are employed in this Institute.

A.2662. Can you tell me what rivers you mean?—I have not the names of the rivers in mind at the moment, but if you want them I can supply them.

A.2663. You say they have silted up?—Yes.

A.2664. Why have they silted up? I have never heard of rivers being silted up; canals silt up. In the case of rivers if there is too much velocity they turn their course and make a new course for themselves?—The alluvium that is brought along with the water settles down.

A.2665. What is the velocity of the rivers which you speak of?—This information has been supplied by the members.

A.2666. You will supply this later on, I suppose?—Yes.

A.2667. *Sir Thomas Middleton:* How many persons are represented by the Association? What is the membership?—We have got more than 75 members.

A.2668. Of the 75 members how many have received a technical education or taken degrees in colleges like yourself?—I have not got the exact number, but it is about 50.

A.2669. So that a substantial proportion, the majority, consists of persons who have had a University or college training?—Yes.

A.2670. We understand that this memorandum was prepared by a committee of the Association; is that so?—The Questionnaire was placed before a general meeting and when it approved of the idea of giving replies to it, a committee was appointed to draw up the replies which replies were next discussed in the general meeting.

A.2671. Individual members of the committee would be responsible, I suppose, for the drafting of individual sections?—After drafting, this was again submitted to the meeting, and it was approved by the whole meeting.

A.2672. On page 293, with reference to recruitment, you are looking forward to a time, I take it, when the great majority of the persons engaged in research will be Indians. This is what the Association has been looking forward to in writing this?—Yes.

A.2673. And your view is that there should be scope in any scheme for allowing promotion from the lower to the higher grade without difficulty? Is that your intention?—Yes, that is so; not as a matter of course, but on merit. We would like that some of these posts should go to men in the lower grade.

A.2674. At the present time do promotions take place? Have they taken place in the past?—In two cases they have taken place.

A.2675. And you think that there ought to be many more such promotions? —Yes.

A.2676. The scheme you are preparing will deal with that point?—Yes.

A.2677. What is the initial pay of the grade in which you serve?—The initial pay is Rs. 250, that is of Class II officers, which is the same as the Provincial Service.

A.2678. Did you enter the service at Rs. 250?—No, when I entered, it was Rs. 200.

A.2679. What was the maximum at that time?—Rs. 250.

A.2680. When you started on Rs. 200 the possibility of increase was limited to Rs. 300?—Yes.

A.2681. What is the present maximum?—Rs. 800.

A.2682. So that entering at Rs. 250 officers in your position can rise to Rs. 800?—Yes, if they enter at the beginning.

A.2683. *Sir Henry Lawrence:* What are the increments?—Rs. 20 up to Rs. 600 and afterwards Rs. 25. But as we were promoted after 14 years' service it is doubtful whether we would reach the maximum.

A.2684. Did you join Government service on Rs. 200?—At Pusa I joined on Rs. 200.

A.2685. Originally when you joined?—At Poona I joined on Rs. 50.

A.2686. *Sir Thomas Middleton:* About what year did you join the service in Poona?—1908.

A.2687. And was that about the ordinary joining pay of students who were passing through the Poona College at that time?—No; the joining pay of the ordinary agricultural graduate was Rs. 30. But as I was a graduate in Arts as well as in Agriculture I was given a special higher start in pay.

A.2688. Can you tell me what the existing rates are there?—They begin on Rs. 100.

A.2689. Any graduate in agriculture who gets employment starts on Rs. 100?—Yes.

A.2690. *Sir Henry Lawrence:* That is not quite correct?—That is my information; but it is not less than Rs. 80.

A.2691. *Sir Thomas Middleton:* What I wanted to get at was the rise that had taken place on account of the increase in the cost of living. The agricultural graduate who formerly got Rs. 30 now gets how much?—Between Rs. 80 and Rs. 100.

A.2692. Does your Association hold the view that the recruitment of graduates to the service should in all cases be on one level, so that the higher posts should be gained by promotion?—We would not say all; but about 50 to 60 per cent should be by promotion.

A.2693. Turning to page 294 of your précis, I do not see what difference there is between the functions of the Agricultural Organiser that you ask for and those of the present District Agricultural Officers?—We would like to extend the functions of the District Agricultural Officer to the sub-divisions of the district and in addition to the present functions we would like this officer to enquire from the agriculturists themselves what are the exact improvements that they require. For example, the agricultural officer is at present engaged in bringing home to the agriculturists the improvements that have already been made by the department; but we would like him also to enquire what improvements the agriculturist himself requires, because it is just possible that the improvements made by the department are not necessarily those which the agriculturist himself would carry out in practice immediately.

A.2694. By introducing the term 'Agricultural Organiser' you are not thinking of a new officer but of increasing the number and extending the duties of the men who are of the type at present employed?—Yes, and therefore we have given him the name of organiser.

A.2695. Under "Field and Laboratory Facilities," your conclusion is difficult to follow. You say, "But if we compare the output of the Rothamsted Experiment Station with the work turned out at Pusa, we suffer in comparison. The reason for this is either want of skilled workers, or deficient organisation." These are not the only reasons. You cannot compare, for example, work that is going on in Pusa and work going on in Rothamsted. Rothamsted is an institution which is mainly devoted to the study of crop production, whereas you have several distinct sections of work in Pusa. If instead of comparing Pusa with Rothamsted you were to compare the publications of the plant breeding section here and those of the Plant Breeding Institute at Cambridge, you would have a legitimate comparison, and if in comparing Pusa with Rothamsted you counted the number of chemists that work here and there you might have a legitimate comparison. It seems to me that the reason is not necessarily either want of skilled workers or deficient organisation but may be due to confused thinking on the part of your Association. I think you must examine this point again, because you have made what seems to me to be a very severe criticism of Pusa?—We took Rothamsted simply because it was an institution well known to some of us on account of its publications to which we had to refer constantly in connection with the publications that we were also issuing from this Institute. We might quite well have compared the other institutes as well, but we thought that these two causes are to a certain extent responsible. We may have put it rather too strongly, but then we feel very strongly on the point, and if it is desired that we should compare other institutes, we should be quite willing to do so.

A.2696. You do not think that the amount of publication on the part of Pusa is sufficient, that is your feeling?—Yes, it is not sufficient, and also it is not considered of sufficient importance by the scientific world. In the importance attached to the Rothamsted publications and the Pusa publications we suffer in comparison.

A.2697. *Sir Ganga Ram:* Have you seen Rothamsted?—We are talking of publications of Rothamsted.

A.2698. But have you visited Rothamsted?—No, but I have come in contact with workers at Rothamsted.

A.2699. *Professor Gangulee:* Do you know when the Rothamsted Station was started?—I know it is many years since it was started and it is getting the advantage of having worked for a long time. We were, however, comparing the work done and publications issued from the Rothamsted Station and the Pusa Institute in the last ten years.

A.2700. It was started in the middle of the nineteenth century, was it not?—Yes.

A.2701. When was the Pusa Station started?—In 1904.

A.2702. *Sir Thomas Middleton:* On page 294 you say that unfortunately soil survey has been ignored. Do you mean by that that the soil survey of Bihar and of other Provinces of India has been ignored or that the examination of the Pusa soils has been ignored?—It is not quite clear from this whether we mean Pusa or the whole of India, but I think, if I remember right, we mean the whole of India; the soil survey as such is not carried out throughout the whole of India, nor has it been begun.

A.2703. Have you any conception of what a soil survey of the whole of India would mean?—We have, but we think a beginning should be made.

A.2704. Do you think you know how to begin?—We have a soil survey made in the Madras Presidency of some of the types of soils that have been dealt with by that department.

A.2705. *Sir Ganga Ram:* You say a soil survey has been done in the Madras Presidency?—It has been done in some of the districts.

A.2706. Can you tell us of any publication with regard to that?

A.2707. *Sir Thomas Middleton:* you were thinking of a soil survey of the type of the Madras soil survey?—Yes.

A.2708. Sampling of soils and examination in the laboratory; that is not what is usually meant by a soil survey, but that is what you are thinking of at present?—Yes, that is what we are thinking of at present, the examination of the soils of different types.

A.2709. Taking samples, bringing them to the laboratory and examining them?—And mapping out exactly where those types of soil are met with in the districts.

A.2710. If you had confined your object to the first, I think your suggestion would have been better, because you will find when you come to mapping out that difficulties arise. In the next paragraph you remark that either for lack of co-ordination, or due to a deficient organisation, or for want of skilled workers, the analyses have not been corrected and standardised. I do not quite understand what that means. Is it your meaning that you have not devised standard methods?—Yes, we have not got standard methods adopted by the different departments and the methods themselves have not been completely standardised; wherever they have been done by the different methods it has not been shown how they can be correlated.

A.2711. Is it not the case that investigations on methods of analysis are at present being undertaken by the Chemical Section?—Investigation is being undertaken but not in the complete way that we would have liked. Some methods have been undertaken and some methods have been made official.

A.2712. What I do not understand is whether you complain that in making analyses standard methods have not been followed, or that no attempt has been made to improve upon existing standard methods?—We do not know which standard methods this department would like to follow, the methods followed are sometimes different.

A.2713. But under different conditions it may be necessary to vary the method?—Yes, but if we have a standard method, if it is necessary to vary the method, we would know that the particular method varies from the standard method and the reason why.

A.2714. You yourself are not familiar with this particular work, methods of analysis?—No.

A.2715. Then you express the view that there ought to be technological laboratories, so that suggestions which arise in the course of your investigations might be worked out on a large scale. That is item 5 on page 295. On the next page you suggest certain things for attention; you refer, for example, to milk products such as casein, milk powder and other agricultural subjects; that is the kind of thing you had in view?—Yes.

A.2716. On page 296, paragraph (iv), with regard to agricultural education, you say training in agriculture should be made attractive by teaching the boys to solve the agricultural problems of the locality. Has your Association attempted to discuss in detail how this could be done? Has it ever tried to prepare an experimental syllabus which teachers might employ?—We have not got a particular syllabus, but what we mean thereby is that in varied tracts, sugarcane tracts or particular crop tracts, agriculture would be more attractive to the boys of that tract if the problems of that particular crop or that particular locality were tackled.

A.2717. I think everyone will agree with that view, but you recognise, many of you having been students, that a teacher has great difficulty in introducing an experimental course, and what I asked was whether your Association had even given attention to the framing of experimental courses of this sort. Have you discussed such matters as the improvement of teaching?—What we think is that if particular experiments on those crops are carried out by the teachers, it will be more useful than simply talking on general agriculture.

A.2718. That is all you mean? You have not as an Association discussed questions of agricultural education from the technical point of view?—No, not from the technical point of view.

A.2719. All of you here are in a favourable position for discussing such questions, because you have all been through agricultural colleges and have had experience?—Yes.

A.2720. I wondered to what extent you have tried to improve agriculture?—We did not like to go into the details of the methods of preparing curricula and that sort of thing.

A.2721. I was not asking with reference to the preparation of this précis; I was asking with reference to the meetings of your Association. Are such matters discussed at the general meetings of your Association?—These matters are discussed in a separate association for the purpose; there is a separate association formed for the purpose of discussing these technical matters.

A.2722. In Pusa?—Yes.

A.2723. What is the name of that association? Are you not a member?—I am a member, it is an association of the assistants; it is called the Pusa Scientific Association.

A.2724. You commend a method of providing employment for middle class youths which we have had before us in many localities. On page 296 you suggest they should be provided with capital and with what you call decent sized blocks of land. Has the Association discussed this in detail, what is meant by a decent sized block of land? How many acres?—Of course I am not in a position to give the exact acreage but it should be of such a size as to yield a decent income.

A.2725. I am afraid it has not been given a decent discussion. This is a very important subject and I had hoped that it would have got a decent discussion from your Association?—If particular areas were referred to we would have given the exact acreage that would be necessary, but we did not know whether the land referred to was dry farming or irrigated tracts.

A.2726. *Sir Henry Lawrence:* What do you regard as a decent income?—I would regard Rs. 1,000 per year as a decent income.

A.2727. *Sir Thomas Middleton:* Have you made any estimate of the capital that would be required to earn a thousand rupees?—If the price of the land were not taken into consideration we consider that about Rs. 500 would be required. We are not taking into consideration the price of the land.

A.2728. Nor the man's own labour?—No.

A.2729. There is another important point on page 297. You think that agriculture should be introduced into high schools and that when boys come to study the subjects, chemistry, physics and botany, they should be required to get up these subjects for the Matriculation more or less from an agricultural point of view. That is your view?—We have provided for two kinds of people. One is for a class which would finish their education at the Matriculation standard or the school final. There we would have more practical agriculture. Those who go through the collegiate course would be required to learn science along with practical agriculture and, as they have to learn science, a little less attention to agricultural education should be given in the high schools as they would get it in the college.

A.2730. The object is good, but you as a student must know that getting up all these science subjects for the Matriculation is a heavy task and that the preparation in chemistry and physics at the present time is very indifferently done, the amount of chemistry and physics taught in Indian high schools is really very limited, so that a student has got to get his preliminary scientific knowledge at the college intermediate stage. Do you not think that it would be a mistake to add an additional subject like agriculture to the already heavy course which a Matriculation student has to follow? That is my difficulty?—We have dropped some of the subjects included in the present curriculum.

A.2731. You have modified the Matriculation examination?—Yes, we have substituted these subjects for the other subjects that we have taken out such as history and classical language. We have simply taken English or vernacular, mathematics and these subjects; the other subjects we have dropped.

A.2732. It is not possible to frame an opinion on the scheme that you present in this general form, but would your Association be prepared to draft what one might describe as an ideal syllabus for the Matriculation examination? Then we should be able to see whether it might be acceptable or not?—The syllabus that we have drawn up does not interfere with the ordinary Matriculation syllabus. We have provided this syllabus especially for those people who would like to take agriculture as a practical subject and dropped out those theoretical subjects with which they have not got much concern at present and which are introduced as a sort of literary course.

A.2733. You are talking of the syllabus for the School Final examination now, not the Matriculation?—In most Provinces the School Final and Matriculation are being combined.

A.2734. *Professor Gangulee:* Have you actually drawn up the syllabus or is it still vague?—We have put down only the subjects to be taught and have not entered into the drawing up of a detailed curriculum.

A.2735. *Sir Thomas Middleton:* Then if they are combined, the Matriculation requirements rule the examination. Is not that so?—Yes.

A.2736. *Dr. Hyder:* On page 292, you say that all schemes drawn up by the Council should be submitted to the Finance Committee. Are you referring to the Standing Finance Committee of Pusa or to the Standing Finance Committee of the Assembly?—To the Standing Finance Committee of the Assembly.

A.2737. But these things do appear before the Standing Finance Committee of the Assembly?—We do not mean that these funds should be in the hands of the Institute.

A.2738. The Standing Finance Committee exercises a very rigid control over every rupee that is spent and it would be pleasing to the members of that body to have the support of officers of Government. Now then, will you please turn to the next page? Have you not got a Board of Editors for publications?—Yes, we have.

A.2739. Would you like to have a larger Board?—Yes.

A.2740. I do not know whether you have done any work of this kind, but it really is a one man's job; an editor must be an autocrat. Now then, will you refer to post-graduate training on page 293? If this Institute were affiliated to some Indian University then that would involve a certain measure of control by the University over the Institute. Would you like to have that sort of control?—When we drew up this memorandum we thought that it should be regularly affiliated to the University, but if it is desired that the University should not have any control over this Institute we would be satisfied if, as I was told recently, the Heads of sections are willing to take students for the Doctor's degree in any of the Indian Universities provided of course there are seats. If this fact is made known at the time of advertising for applications for admission into this Institute, we would be satisfied.

A.2741. I want you to be quite clear about this matter of affiliation. In the case of some Universities there cannot possibly be any affiliation because they are teaching residential Universities, *e.g.*, Dacca, Benares, Lucknow, Aligarh, etc. You could only be affiliated to some territorial Universities and rigid conditions to affiliation are laid down. If this Institute is not prepared to accept the conditions laid down in the Regulations of the Universities I do not know how your Heads of sections can introduce boys at the time of inviting applications to an examination of the Doctor's degree of some Indian University?—We have many Universities granting the highest degrees possible for the work done in this Institute. For example, we had three degrees already granted to three Assistants for work done in this Institute.

A.2742. By what Universities?—The Calcutta and Bombay Universities. The Master's degree was granted by Calcutta and the degree of Master of Science by the Bombay University.

A.2743. I have not got the Regulations of the Calcutta University but there are, as you know, conditions attached to this affiliation; and, as regards this degree granted by the University of Bombay, if you read the Regulations you will find that affiliation carries with it a certain measure of control?—So far as I understand the Bombay and Calcutta Universities are willing to grant degrees provided the work is done at any recognised institute; it need not necessarily be affiliated.

A.2744. There could be no granting of degrees by, say, the University of Bombay as regards study at some institute in Japan for instance, unless the Japanese Institute were affiliated, and therefore were recognised?—I got my degree from the Bombay University.

A.2745. Yes, because you were a graduate of the Bombay University?—Yes.

A.2746. That is a different matter?—But students admitted here are already graduates of their Universities, and the same also applies to Calcutta.

A.2747. Yes, in the case of Calcutta and Bombay. But you have, I understand, students here from other Universities and I do not know how you are going to give a Doctor's degree to a student coming from the United Provinces or the Punjab. The Bombay University would not recognise that. It may solve the difficulty of students coming from that particular University, but I understand that here you have students from all over India, from different Universities?—When English Universities like Oxford, Cambridge and London recognise degrees of Indian Universities there should be no difficulty for recognition of degrees of residential Universities by the territorial Universities.

A.2748. With regard to the duration of the course, take the case of a Matriculate. After joining he will get a degree in Agriculture after 4 years; is not that so?—Yes.

A.2749. Then, you want to give him the Master's degree in one year?—Yes.

A.2750. I will read out to you the regulation of the Bombay University. " Each candidate for the Degree of Master in Agriculture must be a graduate in agriculture of not less than three years' standing and must have been engaged in the practice of agriculture, or of work or research in connection with agriculture for a period of at least three years after receiving the Degree of Bachelor or Licentiate of Agriculture." You want to reduce the period?—Yes. The Bombay University is a bit conservative. It grants only the Master's degree. It has not yet given any Doctor's degree in any subject and therefore the degree of a Master in the Bombay University is equal to that of a Doctor in some of the other Universities.

A.2751. Let us consider three stages, the B.A. degree, the Master's degree and the Doctor's degree. For B.A. you require 4 years; for M.A. you require at least 2 years and although there is no period fixed for the Doctor's degree, you require at least three years. You want under your scheme 4 years for the B.A. degree, one year of the M.A. degree and 2 years for the Doctor's degree. Is that so?—Yes.

A.2752. But most of your suggestions do not tally with the regulations laid down for the obtaining of such degrees by the Indian Universities. That is surely a lowering of the standards?—We would be willing to extend this period by about one year, if that is considered essential by the University Regulations. Instead of 7 years we would extend it to 8 years; 4 years for the B.A., 2 years for the M.A. and 2 years for the Doctor's degree.

A.2753. Even then you get into conflict with the regulations of most of the Indian Universities. Here is the regulation for obtaining the Doctor's degree of the University of Madras. It says that the degree of Doctor of Science can be given only when three years have elapsed from the time when the student took his degree of Master of Science?—The course here at Pusa is for 2 years and in this period of 2 years sufficient research work is being done. The conferment of the degree depends upon the work that is done and the quality of the work done is of sufficient importance to be recognised by the Universities. It is immaterial whether the number of years is three or two

Mr. N. V. Joshi.

A.2754. Let us turn to the University side of the matter. Do you think that the Indian Universities are capable of dealing with publication of theses which will be submitted from Pusa? Do you think that most of these Universities have Chairs in Agriculture and Chairs in many of the natural sciences?—They have got Chairs in Natural and Physical sciences.

A.2755. Take the case of students studying entomology or mycology. Have you a Chair for those subjects in the University of Bombay?—The Agricultural College is there.

A.2756. The whole thing will come back to Pusa like a boomerang. The students will be taught here, their work will be done here and their examiners will have very little say in the matter?—My thesis was examined by the Bangalore Institute.

A.2757. *Sir Henry Lawrence:* On that you were given an M.Sc. degree by the Bombay University?—Yes.

A.2758. *Dr. Hyder:* With regard to the matter of promotion from the provincial ranks, how would your suggestion of 50 per cent of the posts fit in with the general scheme of Indianisation? In the case of the Indian Civil Service or the Police, you know that the ideal is to have 50 per cent posts for members of Indian domicile and 50 per cent for members of non-Indian domicile. It does not mean that 50 per cent of persons of Indian domicile should all come from the Provincial Civil Service. You want everything for the Provincial Service?—We are looking to the time when the Imperial Agricultural Service will be entirely manned by Indians and of that we require this 50 per cent.

A.2759. That is perfectly correct and I follow you there. But according to you this 50 per cent would be entirely confined to promotion from the lower ranks?—Yes, and 50 per cent from direct recruitment. We are talking of the time when the policy of Indianisation will be given effect to and then there should be 50 per cent direct recruitment of Indians and 50 per cent from the lower ranks.

A.2760. That proposal would not fit in with the general scheme of Indianisation. No such percentage is laid down for promotion from the ranks below?—It is not a question of laying down an exact percentage. It is a question of bearing this fact in mind and giving promotion to men of the lower ranks; otherwise the position would be that students trained in this Institute would be given posts in the Imperial Service by direct recruitment and the people responsible for carrying out their education from the beginning would have to serve under them. Therefore the students passing from this Institute would be the direct superiors of the men in the Provincial Service.

A.2761. *The Raja of Parlakimedi:* You know that Agriculture is a Transferred subject in every Province and Irrigation is Reserved. You also know that agriculture and irrigation go hand in hand. Have you got any suggestions to make on that point?—Our Association has not thought out the matter about Transferred and Reserved subjects, and I would not like to venture to express an opinion.

A. 2762. On page 293 you say, " unfortunately in India this aspect of the organisation of research has not been properly appreciated ". Are you satisfied that the public know what is going on here?—What we mean to say is that the sectional meetings that were started are no longer held and we would like to have them revived. When we say it has not been recognised in India, we mean that it has not been recognised by the different Provinces in India or the different Ministers, so to say. They have not appreciated the advantage of these sectional meetings and they have failed to provide funds for sending their representatives.

A.2763. You do not mean the public?—No.

A.2764. On page 294 you compare the work done here and the work turned out at the Rothamsted Experiment Station. May I know whether Pusa has got the same advantages as the Rothamsted Experiment Station has so far as funds, situation and standing are concerned?—Of course, Pusa has not got the same standing.

A.2765. Would you take that factor into consideration?—When we drafted this note we took these facts into consideration. When we say that we suffer in comparison we mean that we ought not to have suffered so much in the natural course of things. Although we follow the practice of the Rothamsted Experiment Station in many ways, we find that we are still lagging behind. That is the opinion of the Association.

A.2766. You mean to say that you have taken the whole situation fully into consideration?—Yes.

A.2767. On page 294 you have made certain remarks about lack of knowledge of cultivator's problems and 294 you talk about the language difficulty. May I ask you to make your proposals more definite. They are rather vague?—I may tell you that we do not attach so much importance to the language difficulty. But as regards paragraph 2 on page 294 regarding the lack of knowledge of the cultivator's problems, we would like to submit a further note of explanation. (*Vide* Appendix).

A.2768. Then you propose the introduction of agriculture as a subject in the schools?—Yes.

A.2769. What language do you propose to have as the medium of instruction at different stages?—We thought about the question of the medium of instruction; I think the medium of instruction had better be left to the Education Department to work out; it matters very little, so long as the subjects that we suggest are taught.

A.2770. And efficiently also?—Yes.

A.2771. Do you not agree with me that they should be taught in a manner that will be easily assimilated by the students?—Certainly.

A.2772. That you would leave to the educationists?—Yes.

A.2773. *Sir James MacKenna:* Who started this Association?—It was started as a result of several meetings that we had, and the general feeling was that we should have a sort of Association to represent our grievances.

A.2774. Who is the leading spirit?—I am afraid I cannot tell you.

A.2775. Who are your executive committee?—One man is chosen from the different classes, *e.g.*, gazetted officers, scientific assistants, fieldmen, etc.

A.2776. Am I correct in thinking that the Association is more concerned with service questions than with agriculture?—Yes, primarily it is intended for that.

A.2777. When you joined service, you were getting Rs. 50 in Poona?—Yes.

A.2778. What did you join as?—I joined as a Demonstrator in chemistry.

A.2779. What are you drawing now?—Rs. 520 a month.

A.2780. Rising to the Rs. 800 grade?—Yes.

A.2781. How many years' service have you had?—I joined in 1908; I have put in 18 years' service.

A.2782. And, during that time, you have risen from Rs. 50 to Rs. 520. How much did your education in bacteriology cost you?—It has not cost me anything, because I took pains to learn the subject myself at home. When I joined on Rs. 50, I was told to carry on some of the experiments on the *rab* system of cultivation besides my usual work of demonstrating in chemistry, for which I was chiefly engaged. I was studying chemistry and geology also for my B.Sc. examination.

A.2783. *Professor Gangulee:* Why did you learn it?—I was asked to carry on an investigation into the *rab* system under Dr. Mann in my spare time, after taking the classes, and I specialised in it of my own accord as I wished to do the work thoroughly.

A.2784. In which year was that?—1908.

A.2785. *Sir James MacKenna:* You say, "The delay in publication of the results obtained by research workers in the various departments of agriculture in India hampers to a great extent the progress of research." Is it not a fact that in every publication of the Pusa Institute there is noted at the top "Received for publication on such and such a date"?—Yes, that is so.

A.2786. And is it not a fact that it is the etiquette of scientific workers to give priority in any piece of investigation to a statement of that kind?—Yes.

In that case, there is no particular hampering of research due to delay of publication in Pusa.

A.2787. *The Chairman:* Have you got the objects of your Association printed or typed?—Yes, we have.

A. 2788. Would you hand me a copy?—We have given them in the beginning of our note.

A.2789. Have you a copy of the by-laws?—We will supply you with one.

A.2790. *Professor Gangulee:* Could you give us also the articles of Association?—Yes.

A.2791. You have told us that 50 of the members belonging to your Association are research workers?—Yes, about that number.

A.2792. You talk about the establishment of a scientific brotherhood; have you established that brotherhood amongst those 50?—Yes, to a certain extent.

A.2793. What do you actually mean by scientific brotherhood?—The spirit of helping the scientific worker in different aspects.

A.2794. Do you discuss scientific problems in your Association?—There is a separate Association, called " the Pusa Scientific Association ".

A.2795. I am asking you about this particular Association of which you are Secretary?—The Pusa Scientific Association had the prior existence, and this Association did not take up that particular branch.

A.2796. You are now here before us as the Secretary of the Imperial Agricultural Department (Pusa) Association. I want to know whether, at any time, you have discussed scientific problems amongst yourselves?—This Association did not take up those duties, because the scientific members of this Association are included in the Pusa Scientific Association.

A.2797. This Association, although they have 50 members doing research, have never at any time discussed any scientific problem?—No.

A.2798. From that one could say that you have not developed the spirit of scientific brotherhood that you would like to see established; am I right?—The same persons who are members of this Association are also members of the Pusa Scientific Association and the mere fact of the non-amalgamation of the one with the other does not mean that we have not got the spirit of brotherhood, because in the Pusa Scientific Association we do discuss scientific problems.

A.2799. When was the Pusa Scientific Association formed?—About 3 years ago.

A.2800. It is mostly composed of Indians?—Yes.

A.2801. Do you discuss scientific problems there?—Yes.

A.2802. Do you have minutes of the proceedings?—Yes.

A.2803. Could you give us a list of the subjects you discussed for the last six months?—We submit a précis of these discussions to the *Agricultural Journal**, and I think we could supply you with them.

A.2804. You feel the necessity of establishing sectional conferences; how many conferences of your own section were held?—Two.

A.2805. Did you take part in those conferences?—Yes.

A.2806. Did you read any paper?—There was no question of reading any paper, but we had to discuss several subjects that came before us.

A.2807. Did you participate in the discussion?—Yes.

A.2808. I cannot understand what you really mean by " unsystematised research " on page 294; will you explain?—By unsystematised research we mean research undertaken not on the basis of a full survey of the cultivator's problems, but on any subject that the scientist himself thinks worth tackling.

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* *Agr. Jour. of India*, March, 1926.

A.2809. Could you tell the Commission a single item of research undertaken by your section, which may be classified as a piece of unsystematised research?—By unsystematised research we mean that the kind of work that we do is not necessarily connected with the agriculturist's or ryot's needs as given out by the agriculturist or by the Agricultural Department; we have to select our own problems.

A.2810. You are confusing the whole situation, I am afraid. I want to know from you whether you can tell the Commission that your section undertook any piece of research which could be classified as unsystematised research?—I want to know whether you mean unsystematic work.

A.2811. Unsystematised research; I take the words you have used here?—We are not talking about unsystematic work; we are talking about research on points undertaken at our discretion. We are responsible for the research that we undertake; we are not told what work is desired from our section by the cultivators or the agriculturists or the Agricultural Department.

A.2812. You want the problems to be tackled by your section to be dictated by cultivators?—Not dictated.

A.2813. Suggested?—Yes.

A. 2814. Are you familiar with foreign scientific journals?—So far as my work is concerned, I am.

A.2815. Would you agree with me that Pusa has established a scientific reputation?—It has a certain amount of scientific reputation.

A.2816. It has established a certain amount of scientific reputation. Please turn to page 294 and tell me how could that reputation be established under the conditions alleged by you, that is, want of skilled workers and deficient organisation?—There we are referring to the fact that our reputation is not equal to that of Rothamsted.

A.2817. I am not referring to Rothamsted at all; that has been done by Sir Thomas Middleton. This institution was established in 1906, and in 20 years' time has turned out work on which it can base its reputation. You allege here that there is a want of skilled workers and that there is deficient organisation and unsystematised research?—We mean thereby that our reputation would have been greater if these causes did not exist.

A.2818. With regard to your own research, how many years have you been engaged in this Institute?—About 16 years.

A.2819. Could you tell the Commission the nature of your own research, and whether you have done so systematically?—I was working with Dr. Mann on the *rab* system of rice cultivation in Western India, and on the bacteriological rot of stored potato tubers with Mr. Hutchinson. I was carrying on work on the bio-chemical decomposition of organic manures and green manures, and I have published several articles on that subject in the *Agricultural Journal of India.* I have got out 2 memoirs in my own name, for one of which I obtained a science degree of the Bombay University, and I have a bulletin on the manurial value of the different parts of green manure; recently I have submitted a paper on the economic method of green manuring to the Science Congress.

A.2820. How many of these various researches were undertaken on your own initiative and how many at the suggestion of your superior officers?—Bacteriological rot and the *rab* system of rice cultivation were the suggestions of my superior officers; the bio-chemical decomposition of green manure and others organic manures was taken up by myself, after I had assisted Mr. Hutchinson in some of his work. The independent memoirs were practically on my own suggestion; they are of theoretical value only; the bulletin and Science Congress paper that I am talking of are but the development of my own work on the decomposition of green manures and other organic manures.

A.2821. In that work, you received no assistance whatever from the Head of your section?—Nothing except encouragement and discussion on some of the questions, but without the encouragement of and discussion with the Head of the section it would not have been possible to carry it out.

A.2822. That is precisely the point I wanted from you. In reply to the Chairman you stated that when problems of research are undertaken, the Heads of sections do not take the trouble to explain the scheme to you as a whole and do not take you into confidence when they chalk out their lines of research. Has that been your own experience in your own work?—The problems that I was dealing with generally had no concern whatsoever with the Heads of the different sections. They were entirely taken up in our own laboratory.

A. 2823. I am only talking about your own section?—When joint schemes are discussed with the Heads of the sections then there is a possibility of this happening. When the problem is carried out in one laboratory and is confined to one laboratory then this does not happen.

A.2824. So far as your own work is concerned you have no complaint?—No.

A.2825. Have you read much about the research organisations of other countries?—I have read something; not much.

A.2826. So the remarks that you make here with regard to research organisations are based on insufficient knowledge?—There is a difference. Personally I may not be acquainted with them, but the other members who drew up the answers and made suggestions have had a certain amount of knowledge of research organisations.

A.2827. Then you make suggestions with regard to the Provincial Departments of Agriculture. Have you followed their work closely? How activities like demonstration and propaganda are carried on? I want to know whether you are in touch with the Provincial Departments of Agriculture?—We are to a certain extent; I am personally with one or two Provinces and the other members with other Provinces.

A.2828. When drawing up this précis did you consult the members of your Association?—Yes.

A.2829. Has any member of the Association any knowledge of rural economics or rural conditions?—We have got a knowledge of rural conditions, but have not made a study of rural economics as an academic subject.

A.2830. *Mr. Calvert:* Do I gather from your answer to Prof. Gangulee's last question that your Association does not interest itself in rural economics?—It has interested itself in rural economics; but we have not got a knowledge of rural economics as studied, say, in the colleges.

A.2831. On page 291 there is a note about the average yields in various countries. Is that a fair sample of the economic knowledge of your Association?—You mean the figures that we have given?

A.2832. Yes?—We have given these figures from the different references that we could get.

A.2833. You have deduced from those figures that we are not producing as much as we should. Is that a fair sample of the economic knowledge of your Association?—I do not know whether it is economic knowledge, but we think that, because other countries are producing more and there is a possibility of getting greater yields in these different commodities, there is no reason why, unless proved to the contrary, our country also should not come to the same position as that arrived at in other countries.

A.2834. Which do you think has a higher yield in wheat, the United States of America or the Punjab?—We are talking of the whole of India; we have not specially studied the Punjab wheat. But I enquired and found out that the yield of wheat in the Punjab comes to about 17 to 22 maunds in the irrigated tracts.

A.2835. *Sir Ganga Ram:* You enquired from where?—From the Lyallpur College students who had come to the Science Congress.

A.2836. *Mr. Calvert:* On page 292 you say, " we shall not only lose our hold (of the export markets) with disastrous consequences to our agricultural community, but also our domestic markets may be invaded by foreign producers as they have done in the case of sugar." Do you think those two processes can go on together?—I think the losing of the home markets would come subsequently, subsequent to losing our export markets.

A.2837. *Mr. Kamat:* With reference to your remarks about a certain proportion of appointments in the higher service being given to deserving candidates in the lower groups (page 294) will you please tell me what is precisely the present difficulty? Is it statutory or is it under the executive rules or what? That is to say, supposing there is a man who has distinguished himself here at Pusa by scientific work, is there any inherent difficulty in the way of his being taken up by a Minister of a Province for a superior post in the Provincial Service?—There is no statutory difficulty in theory, but in practice we find that men here are not taken up by the Provinces.

A.2838. You have gone through the Lee Commission's recommendations, I presume?—Yes; we have.

A.2839. They have made it perfectly clear that recruitment for the Agricultural Service is now entirely in the hands of the Ministers?—Yes.

A.2840. And if they choose they can obtain their recruits through the Public Service Commission which has now been appointed?—Yes.

A.2841. Under the circumstances is there a clear-cut statutory difficulty? Or is it only due to the present operation of executive rules? Have you ascertained that?—The difficulty is only in practice; it does not exist in theory.

A.2842. So it is only the practice you have to break down if you want your point to be carried?—Yes.

A.2843. On page 294, amongst the list of handicaps you cite the instance of lack of knowledge of cultivators' problems on the part of the officers here. You say " Agricultural Experts who are recruited from abroad are sometimes inclined to transplant the methods obtaining in their country without modifying them according to the local conditions "; and you quote the instance of cattle breeding by crossing the country cows with imported bulls. Your Association thinks that this method of cross breeding is entirely on the wrong lines?—Without having dealt with the indigenous breeds by themselves, it was wrong to have paid so much attention to cross breeding.

A.2844. Is there any other instance which you have in mind, broadly speaking, which could be cited by your Association to show that research work carried on by the superior officers here is on the wrong lines? I want you to be perfectly outspoken?—You mean the research work done by the experts The Association has had no definite instances pointed out by its members. So I am not just now in a position to say anything.

A.2845. You have no particular instance in mind?—Just now I cannot say.

A.2846. It is a question of the interests of science; it is not a question purely of Subordinate and Superior Service?—But the position is this. Unless I am given definite instances by the members I am not in a position to say anything.

A.2847. I need not go into the scientific part of the question. I am just asking you to give an illustrative instance to show how the lines on which the superior officers are working do not reflect the needs of the cultivator?—I have not got any other instances just now but if you want instances that the members had in mind I can give them later on.

A.2848. I do not want to go into the merits of cross breeding, but this instance is quoted by you just to show that there is not that friendly cooperation and that exchange of views between the superior officers here and the assistants when working on a problem that is desirable; is that what you mean by quoting this instance? I wish to make myself perfectly clear. The question I am asking you is not whether their method of cross breeding is right or your idea of breeding is right. You may be right or they may be right; that is entirely a different question. But you cite this instance in your honest belief that the superior staff in their lines of research are divorced from the needs and the minds of the cultivators; is that right? That is the honest belief of your Association?—Yes; that is so.

A.2849. And therein lies the germ of your complaint?—Yes.

A.2850. That the superior officers do not consult you or take you into their confidence when they chalk out their lines of research?—Yes.

A. 2851. What you further desire is a freer exchange of views?—Yes.

A.2852. A more friendly discussion, on and off, between assistants collectively or individually and the superior officers collectively or individually?—Yes.

A.2853. Therefore the question of comradeship only resolves itself into a freer exchange of views with a more friendly feeling?—Yes.

A.2854. Nothing further than that? How many members are there in the Science Section of your Association?—I cannot give you the exact number but there are about 40 or 50 members. It began with 47 members but now it has 38.

A.2855. That you have formed yourselves into an association itself shows that you are beginning to have a sense of brotherhood?—Yes.

A.2856. The fact that you have set yourselves the task of taking up some research work, independently of the problems assigned to you by your superiors for solution, itself shows that you desire to work on a voluntary basis apart from your official duties?—We take up scientific subjects for discussion at the Pusa Scientific Association.

A.2857. And although at the present moment you may not have systematised and standardised your lines of research work which you are doing on a voluntary basis, still that spirit ought to be encouraged?—Yes.

A.2858. To a man of science this should be regarded as a healthy sign?—Yes.

A.2859. *Sir Ganga Ram:* When you speak of land being given by Government to unemployed students, where are the lands of which you are thinking; can you give me specific lists of lands which Government could distribute?—No, we have no specific lists.

A.2860. Then are these Government lands?—We understand there are some colonisation schemes under Government and Government has got some lands.

A.2861. Do you suggest under your scheme that Government should give these lands to students for nothing as a gift, or should sell them, or what?—We have suggested that the price of the land should be paid at the rate of about 3 per cent per annum and be realised in the course of 60 years, the owner after this period holding the land in fee simple, as is done for the landless in Ireland.

A.2862. Do you mean that Government should borrow at 5 per cent and lend at 3 per cent, because 5 per cent is the Government rate now?—No. If we take the value of the land as being 100, Government should realise 180 per cent in 60 years; that is our idea.

A.2863. But should Government do this with its own lands or should it buy the land?—Use its own lands.

A.2864. But where are these lands belonging to Government?—You want to know a specific area?

A.2865. I want to have a list of the Government lands which Government could give to you?—We have not prepared any specific lists of that kind.

A.2866. Will you send me such a list?—Yes, if it is available.

A.2867. I ask you for it. Since this Association has been recognised by Government, have you sent the proceedings to Government?—Not all the proceedings but we send in, annually, the report and the exact number of members.

A.2868. Are you not bound to send the proceedings?—They have not asked us to send the proceedings in detail.

Then it is their fault.

A.2869. *The Chairman:* Have you yourself come across instances where subordinate members of the scientific staff engaged in detailed operations in connection with some scheme of research have not been told what that scheme of research was?—It is difficult to say because, so far as I myself am concerned, if the Head of the section did not tell me everything, I went to him and worried him until I got the information as to why he required a certain experiment to be carried out and why he did not wish other experiments to be carried out; thus I got the required information; but I find that other Assistants have not adopted that practice; they have perhaps not been encouraged to ask such questions, and therefore the complaint has arisen from them.

A.2870. Can you give me a single instance in which Assistants, other than you yourself, have failed, either through lack of the necessary initiative to ask, for information, or through lack of sympathy on the part of their chief, to inform themselves or be informed?—It would be difficult to give an instance on the spur of the moment.

A.2871. I am only asking for a concrete instance. Can you give me a concrete instance?—If we have to give a concrete instance, I think I would rather give it in writing later on than publicly here.

A.2872. Then perhaps you would put in two typical instances. Will you make a note of that?—Yes.

(The witness withdrew.)

The Commission then took evidence in the Central Provinces, the United Provinces and Delhi from 17th January to 22nd February 1927. For the proceedings of meetings, except the evidence of Mr. G. S. Hardy and Dr. D. B. Meek which follows, see Volumes VI, VII and VIII.

APPENDIX.

The Association is of opinion that a survey of the cultivator's problems should be made through the agency of the Agricultural Organisers, *i.e.*, (the district and sub-divisional agricultural officers with the added function of enquiring from and discussing with the actual cultivators as to their needs and the difficulties the cultivators have to contend with).

Out of the problems thus surveyed the problems requiring solution will naturally be distributed by the Agricultural Department among its different experts. This practice should be regularly followed and the department should thus keep itself more in touch with the actual needs of the cultivators, than direct its attention to experiments on machinery or manures which the cultivator cannot afford to buy at present. That is what we mean.

Mr. N. V. Joshi.

Saturday, February 19, 1927.

DELHI.

PRESENT:

The MARQUESS OF LINLITHGOW, D.L. (*Chairman*).

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S.	Sir JAMES MACKENNA, KT., C.I.E., I.C.S.
Sir THOMAS MIDDLETON, K.B.E., C.B.	Mr. H. CALVERT, C.I.E., I.C.S.
Rai Bahadur SIR GANGA RAM, KT., C.I.E., M.V.O.	Professor N. GANGULEE.
	Dr. L. K. HYDER.
	Mr. B. S. KAMAT.

Mr. J. A. MADAN, I.C.S. } (*Joint Secretaries.*)
Mr. F. W. H. SMITH. }

MR. G. S. HARDY, I.C.S., Member, Central Board of Revenue, Government of India.

Memorandum prepared by the Government of India on Tariff Concessions granted in aid of Agriculture.

The concessions given may be classified under 4 main heads:—

I. Manures. (Item 9 of the Statutory Import Tariff Schedule);
II. Agricultural implements. (Item 15);
III. Dairy appliances. (Item 16); and
IV. Water-lifts, sugar mills, oil-presses, and parts thereof worked by manual or animal power. (Item 18.)

These are dealt with seriatim below:—

I. *Manures,* all sorts, including animal bones, have always been exempt from Customs duty. Prior to the passing of the Indian Tariff Act, XVI of 1894, they were exempt as they were not mentioned in the schedules of the Tariff Act, VIII of 1894, and there was subsequently no authority to tax them. They were mentioned for the first time in the Tariff Act, XVI of 1894, where they were shown as free from duty. Although there is nothing specific on the point, their exemption is no doubt due to their value to agriculture.

Chemical manures of certain kinds were subsequently made free from duty in 1898 in deference to the views of His Majesty's Secretary of State for India, who suggested that chemicals which were imported exclusively for use as manures and could not be converted to other uses, except at a prohibitive cost, should be exempted from duty. When the general rate of import duty was raised from 5 per cent to 7½ per cent *ad valorem* in 1916, it was at first proposed to make manures including chemical manures, liable to import duty at 2½ per cent, but the items were retained on the free list at the instance of the Secretary of State. Since then it has become the accepted policy of Government to admit free of import duty chemical preparations used as manures which satisfy the conditions laid down in 1898 and additions to the list of exempted manures have accordingly been made from time to time. The existing list reads:—

> "9. Manures, all sorts, including animal bones and the following chemical manures: basic slag, nitrate of ammonia, nitrate of soda,

muriate of potash, sulphate of ammonia, sulphate of potash, kainit salts, carbo lime, urea, nitrate of lime, calcium cyanamide, mineral phosphates and mineral superphosphates."

II. *Agricultural implements* when constructed so that they can be worked by manual or animal power were liable to the general rate of import duty, *viz.*, 5 per cent up to November 1903.* Agricultural machinery worked by power other than manual or animal, however, came in free of duty as machinery. This position was considered illogical and certain machines restricted to purely agricultural uses but worked by manual or animal power were exempted from import duty in November 1903 by Notification under Section 23 of the Sea Customs Act. It was also stated that additions to the list be made from time to time as other improved implements come into use. Parts of exempted agricultural implements which can be readily fitted into their proper places in the implements for which they are imported and cannot ordinarily be used for purposes unconnected with agriculture were admitted to the concession in 1908 by executive instructions.

In 1916 an import duty of 2½ per cent *ad valorem* was levied on machinery and component parts worked by power other than manual or animal for the first time, but agricultural implements and parts thereof worked by animal or manual labour were retained on the free list at the instance of the Secretary of State. The position before 1903 was thus reversed in 1916, *i.e.*, agricultural implements worked by manual or animal power were allowed free while those worked by other power had to pay duty at variable rates. This anomaly was rectified by Commerce Department Notification No. 6573, dated 2nd October 1920, which extended the exemption to the agricultural implements and component parts to those worked by power, other than manual or animal. Statutory effect was given to this decision when the Tariff Schedules were revised in 1921.

New forms of agricultural implements not ordinarily used for purposes other than agriculture have been added to the free list which now stands as under:—

> "15. The following Agricultural Implements, namely, winnowers, threshers, mowing and reaping machines, binding machines, elevators, seed and corn crushers, chaff-cutters, root cutters, ensilage cutters, horse and bullock gears, ploughs, cultivators, scarifiers, harrows, clod-crushers, seed-drills, hay-tedders, hay-presses, potato diggers, latex spouts, spraying machines and rakes; also agricultural tractors; also component parts of these implements, machines or tractors; provided that they can be readily fitted into their proper places in the implements, machines or tractors for which they are imported, and that they cannot ordinarily be used for purposes unconnected with agriculture."†

III. *Dairy appliances.*—When making suggestions in 1903 as to the agricultural implements to be exempted from duty, dairy machinery and appliances were mentioned by the Inspector-General of Agriculture, but these articles did not find place in the notification eventually issued. Subsequently, in 1904, the Inspector-General of Agriculture specifically asked that dairy machinery of every description might be exempted, and the then Revenue and Agriculture Department expressed the view that the dairy industry, which was an extensive one, should be fostered as far as possible. As a result, certain dairy appliances, when constructed so that they can be worked by manual or animal power, were exempted. Like concessions (I) and (II) this concession was also continued in 1916. In 1920 parts of dairy appliances which can be readily fitted into their proper places in the appliances for which they are imported and which cannot ordinarily be used for other than dairy purposes, were exempted from duty and for the reasons explained in (II) above, the concession was extended in 1921 to the dairy appliances and component parts worked by steam or other power.

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* With the exception of water-lifts, sugar mills, oil-presses and parts thereof.

† Under Government of India, Finance Department (Central Revenues) Notification No. 18, dated 17th June 1926, the following agricultural machines are also exempt from payment of import duty:—

> Beet Pullers, Broadcast Seeders, Corn Pickers, Corn Shellers, Culti Packers, Stalk Cutters, Huskers and Shredders, Potato Planters, Lime Sowers, Manure Spreaders and Listers.

Mr. G. S. Hardy.

The existing entry in the Tariff Schedule reads as follows:—

> "10. The following Dairy Appliances, namely, cream separators, milk sterilizing or pasteurizing plant, milk aerating and cooling apparatus, churns, butter dryers and butter workers; also component parts of these appliances, provided that they can be readily fitted into their proper places in the appliances for which they are imported, and that they cannot ordinarily be used for other than dairy purposes."

In addition milking machines and such component parts thereof as can readily be fitted into their proper places in the machines and cannot ordinarily be used for other than dairy purposes, have been exempted from import duty by the Central Board of Revenue Customs Notification No. 7, dated the 5th February, 1927.

IV. The exemption in favour of water-lifts, sugar mills, oil-presses, and parts thereof, goes back to 1894 (*c.f.* No. 13 of Schedule IV to the Indian Tariff Act, XVI of 1894). The Select Committee appointed to consider that Bill observed: "We have exempted from duty water-lifts, sugar mills and oil-presses as well as all machines ordinarily used in the process of husbandry or for the preparation for use or for sale of the products of husbandry which the Governor-General in Council may by notification exempt." During the general revision of 1921, a suggestion was made that the exemption in respect of water-lifts, sugar mills, oil-presses and parts thereof worked by manual or animal power might be cancelled but the point was not pursued further and they still continue to be on the free list, while those worked by power other than manual or animal pay import duty either at 2½ per cent. under item No. 51 or 15 per cent under item No. 96 of the Statutory Tariff Schedules.

The existing entry reads:—

> "18. *Water-lifts, sugar mills, oil-presses,* and parts thereof, when constructed so that they can be worked by manual or animal power."

Mr. G. S. Hardy.

Replies to the Questionnaire.

QUESTION 21.—TARIFFS AND SEA FREIGHTS.—Except in so far as the general tariff raises the cost of living to the cultivator to a small extent, the Customs importers' duties do not seriously affect the prosperity of the Indian cultivator. The Commerce Department memorandum* contains a list of the many concessions given to the agricultural industry, but of these it may be said that they form a patchwork of individual ideas rather than a carefully thought-out and well-balanced scheme.

2. I express no opinion as to whether it is desirable that all raw materials or accessories of the industry should be admitted free, but will merely indicate some of the directions in which the present concessions fall short of this standard. Item 15 of the Tariff which deals with Agricultural Implements relates only to certain specified instruments. The Government of India have generally proved willing to add to that number any that may be brought to their notice whose primary purpose is agricultural. But to make additions to the list takes time, and concessions cannot legally be given with retrospective effect. An alternative course would be to make all agricultural implements free without specifying any by name. To this there is the objection that it would throw on Collectors of Customs the onus of deciding whether a particular article fell within the definition. Different decisions might be given at different ports; after a time the discrepancy would be discovered and the Central Board of Revenue would issue a ruling, and in this way a body of case-law would grow up round the item. Now this is an admitted defect in other parts of our tariff which has recently been the subject of severe criticism from the Associated Chambers of Commerce, who have complained that under many heads the tariff itself is vague and that the case-law which elucidates it is not available to the public.

3. Items 16 and 18 are similarly specific. Item 9, Manures, is specific only so far as chemical manures are concerned, and in respect of additions to this list the policy of Government is to include only such chemicals as cannot be ordinarily used without further expense for other purposes.

4. Grain and pulse are free, and in so far as they are imported for seed purposes, this constitutes a concession. Imports for food purposes only occur in considerable quantities when there is a shortage in India, *e.g.*, in 1925-26, when wheat exports fell from 1,111,000 tons to 212,000 tons, 35,000 tons of wheat were imported from Australia, so that freedom from duty can hardly be regarded as affecting the cultivator adversely.

5. Seeds, seedling plants and cuttings are liable to 15 per cent duty and imported materials used for irrigation schemes are subject to the appropriate rate of duty.

6. Other parts of the tariff bearing indirectly on agriculture are the duties on agricultural produce. As has been mentioned above, grain and pulse are free. Raw cotton is also free, but consists for the most part of Kenya cotton of which about half is re-exported. The other important items are " sugar," " fruits," and " vegetables " and spices."

The specific duty on sugar (Rs. 4-8 per cwt. for white sugar and Rs. 4 for brown) is at present equivalent to an *ad valorem* duty of about 37½ per cent.

8. The duty on fresh fruits and vegetables is 15 per cent and its rise from 5 per cent to this figure appears to have had a definitely protective effect since, despite the rise in prices, the value of imports has dropped from Rs. 20 lakhs in 1913-14 to Rs. 17½ lakhs in 1925-26.

9. On spices the duty is also 15 per cent but in this case the rate does not appear to have had a depressing effect on the import trade which has risen from 63,704 tons in 1913-14 (including 56,904 tons of betel-nuts) to 70,600 tons (including 63,584 tons of betel-nuts) in 1925-26. The Customs

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**Vide* pages 336-338.

revenue from spices in the latter year was 50 lakhs, and the amount has been increasing annually.

10. The export duties affecting agriculture are those on rice and jute. These are discussed in paragraphs 154—157 of the Report of the Indian Taxation Enquiry Committee, 1924-25. The rates of duty are:—3 annas a maund on rice and Rs. 4-8 per bale of 400 lbs. on raw jute.

QUESTION 26.—STATISTICS.—I would commend to the attention of the Commission the method adopted in Burma for the preparation of the final rice forecast. The forecast is made at an annual conference presided over by the Settlement Commissioner at which the Collector of Customs and the leading rice merchants are present. In Bengal the jute forecasts are prepared by the Director of Agriculture without the assistance of trade advice. They are thus much less accurate than they might be. They are kept secret up to the moment of publication, are the subject of considerable gambling, and frequently exercise a disproportionate effect on the trend of prices.

Oral Evidence.

A.2873. *The Chairman:* Mr. Hardy, you are a Member of the Central Board of Revenue and you are one of the two Members of the Board?—Yes.

A.2874. Your colleague is in charge of accounts and you, Mr. Hardy, are in charge of Customs matters?—We deal with important matters jointly, but I deal principally and primarily with Customs and one or two other matters and my colleague primarily with Income-tax.

A.2875. Officially there is no division of responsibility?—No.

A.2876. What are the functions of the Board?—To administer the revenue collecting departments of the Government of India, at least the principal revenue collecting departments, income-tax, customs, salt, excise and stamps.

A.2877. You have provided us with a short note of the evidence which you wish to put before the Commission. Have you anything in addition to that which you have written which you would like to say at this stage?—I do not think so. I am afraid this note has been prepared hurriedly as I got the Government of India's memorandum which was prepared by the Commerce Department only on Tuesday night.

A.2878. Amongst other things, I think we should like to have from you some measure of the practical difficulties involved in granting further concessions to agriculturists in the shape of free import under license or other such concessions. I take it that the principle of allowing free import under control to approved persons or firms is established in India?—I would not say that; administratively we rather dislike giving concessions to people; we prefer that the concessions should be for a particular article, no matter by whom it is imported.

A.2879. Are there no cases in which persons or firms have certain facilities granted?—Yes, there are one or two, but we would like to reduce them as much as possible.

A.2880. I take it that, broadly speaking, there is a conflict of interest between the industrialist in India who wishes to be protected and the agriculturist who wishes to import free of duty?—Yes; I suppose there is a conflict, in respect of certain articles at any rate.

A.2881. I suppose the industrial concerns are very active in pressing their case upon you?—Their case is now dealt with by the Tariff Board when they are actually asking for protection. On the other hand, the demand for free entry for an article which is manufactured out here would presumably not be given by the Government of India without considering the possibility of such a concession damaging manufacturing interests here.

A.2882. And who would speak on behalf of the cultivators in a matter of that sort?—I suppose the routine procedure would be to consult the Department of Education, Health and Lands.

A.2883. But it is a fact, is it not, that agriculture being in the main a business carried on by small and detached units, agricultural interests are not likely to be quite as vocal where they conflict with those of industrial concerns as are those of the industrial concerns?—I cannot remember any case in which a concession proposed for agriculturists was dropped on account of the existence of such vested interests.

A.2884. Take the case of nitrate of potash. Are you familiar with that? Nitrate of Potash, as you know no doubt, is used as a manure and it is also capable of being used as the raw material in certain processes of manufacture and I understand that there is a tax upon nitrate of potash imported into India?—Yes, it is subject to the general rate of duty as it is not one of the manures which have been definitely specified.

A.2885. Is that not a case in which the interest of the agriculturist is rather likely to go by default?—I am not sure that we have ever heard, until a few weeks ago, of any imports of nitrate of potash for manurial purposes. I am not sure whether we show the figures separately in our Trade Reports. It is produced in very large quantities in India and exported in very large quantities also.

A.2886. I do not wish to exaggerate the importance of a particular case. I am only trying to get from you the general way in which your department and the other departments concerned regard these matters?—Yes: the imports for 1920-21 were 35 cwt.; for 1922-23, 48 cwt.; 1923-24, 21 cwt.; and the next two years they were *nil.**

A.2887. *Mr. Calvert:* What is the advantage of the import duty then if there is no import?—There is no particular advantage in this case; it has never been suggested that it should be removed from the general list. "All other articles not otherwise specified" are liable to 15 per cent duty and I think it only a few weeks ago that somebody importing some nitrate of potash alleged to be for manurial purposes asked that it might be passed free, and it was merely pointed out to him that it was not on the free list at the present moment.

A.2888. *The Chairman:* It has also been suggested to the Commission that, for instance, *berseem* (Egyptian clover) seed might be imported under proper safeguards into the country free of duty. Would that be a difficult matter to arrange?—I do not think so: but for what purpose would the safeguards be required?

A. 2889. As regards *berseem* I imagine there would be no need for safeguards. I was thinking of a case where the seed might be used for feeding purposes as well as for sowing?—We should prefer to have it free altogether I think.

A.2890. You would try to avoid leaving anything to the discretion of your officers at the port?—Yes, that is so, because the institution of inquiries might be embarrassing; moreover they have not got the staff to carry out such inquiries. I think myself that probably a seed of that kind would have to be disinfected on arrival.

A.2891. Under another set of rules? It is of course imported at the moment, and the rules as to quarantine or disinfection would apply to that?—I do not know whether it falls under those rules, but Sir James MacKenna would probably know.

Sir James MacKenna: I think so.

A.2892. *The Chairman:* Do you often have laid before you representations from the Imperial Agricultural Department or Provincial Agricultural Departments? Do they come straight before your Board?—I think we very rarely get such representations; we get representations generally from importers.

A.2893. In the present conditions of development, would you expect the interests of the cultivators as a whole to be watched by the Departments of Agriculture?—I think so. I say we do not get representations from them, but we have, I think, on a number of occasions had representations from importers asking that a particular agricultural implement might be put on the free list. Such representations are accompanied by the support of the local Agricultural Department and very often the implement in question is added to the free list.

A.2894. As regards the importation of agricultural implements your existing practice is to have a detailed list called the free list and various types, are put on to that list as they develop?—Rather as they come to notice on import. These implements come under item 15 in the first part of the tariff which consists of items which are free of duty.

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* India produces large quantities of saltpetre and has exported annual quantities in the last 5 years ranging from 6,600 to 11,700 tons. The average price was Rs. 17 per cwt., while for the very small quantities imported (5 tons in 5 years), the average price excluding duty was Rs. 50 per cwt. It is highly likely that the imports consisted of refined saltpetre and that the importer who recently imported some for manurial purposes into Madras must have been ignorant of the fact that he could have obtained any quantity at much lower prices from the Calcutta market. The export trade has fallen off considerably in the last few years and there is no doubt traders would only be too glad to sell for industrial purposes.

A.2895. And you prefer that to the alternative method of granting free import to agricultural implements, and of building up what you call a system of case-law in order to decide which implements may properly be regarded as "agricultural implements"?—Yes.

A.2896. So that there again you are concerned to ease the responsibilities of your officials?—I do not know really if we as a department or I as an ex-Collector of Customs would mind very much, but I think it is the importer really who is concerned because he does not know what duty he has got to pay unless the specific article or articles are mentioned in the list. Probably the other method in a way would tend to make these things easier for him, because if the thing was a genuine case it would get through at once instead of its having to wait for a reference to be made to the Government for a notification to be issued or for the tariff to be amended; and the tariff can only be amended ordinarily once a year.

A.2897. *Sir James MacKenna:* I do not suppose you are prepared to express an opinion on the suitability of removing the import duty on agricultural products or implements?—From what point of view do you mean: from the administrative point of view, the revenue point of view, or the protective point of view? You have got to consider all points of view. We have to consider the position at any rate from the administrative point of view.

A.2898. You are really more concerned with the application of the tariff schedule which is laid down and you cannot express an opinion on the suitability or otherwise of getting rid of a particular import duty?—We are also concerned with the tariff policy in so far as it is the basis for our revenues. I might say that the other departments of the Government of India would not initiate any change in the tariff policy without hearing our views on it.

A.2899. The particular point I wanted to put to you is that at present there is a 15 per cent duty on seedlings, plants and cuttings. I do not suppose you can express an opinion as to the advisability of getting rid of that?—I do not think we should lose very much duty as things go at present.

A.2900. *Sir Henry Lawrence:* What is the revenue from those heads?—The actual revenue is not recorded but the value of imports of living plants, including bulbs and seed for sowing, was only 1¼ lakhs last year; it has varied between Rs. 40,000 and Rs. 2,00,000 in the last five years, which means a maximum revenue of Rs. 30,000 from the whole head.

A.2901. *The Chairman:* That is produced from the 15 per cent duty?—Yes, on plants, bulbs and seeds. That would exclude oil-seeds which are recorded separately. This item should really be worded "seeds not otherwise specified," but it says "seeds for sowing."

A.2902. *Sir Thomas Middleton:* Would it include garden seeds?—Yes, it would; that is probably what it mainly consists of. Seeds which are also grown as a crop in this country would be shown under the head of that crop I think; for instance, grain, oil-seeds or cotton seed.

A.2903. *Professor Gangulee:* Do you think power pumps should be entered in the free list? I see ordinary water-lifts, when they are constructed so that they can be worked by animal or manual power, are free?—Yes.

A.2904. But I think power pumps are not free?—No, they are 2½ per cent.

A.2905. In view of the extension of irrigation, do you think power pumps should be allowed in free?—I think we should have to enquire whether the type of pump used for that purpose is solely used for agricultural purposes or is also used for other purposes.

A.2906. I see sugar mills are free if they are worked by animal or manual power, but they are not free when they are worked by power?—Yes, I think that is probably a definite defect in our tariff.

A.2907. If you allowed sugar mills worked by power to come in free it might facilitate groups of cultivators to go in for sugar manufacture?—Yes.

A.2908. *Mr. Calvert:* Am I correct in deducing from your answers that the levying of duty on these items such as seeds and power pumps is merely because you are forced to raise revenue and is not a question of policy?—Yes, I think that is so; I am not sure that the removal of duty on them has ever been considered. Why they were not selected to be put on the free list when the tariff was framed in 1894 I cannot say at this date. It was considered that certain items should be put on the free list in order to encourage industry and agriculture in this country, but I suppose they did not think of those particular items, and they have remained subject to the general *ad valorem* rate of duty ever since, which at that time, of course, was only 5 per cent but is now 15 per cent.

A.2909. The main reason for these items of revenue is financial stringency, not policy?—Yes, I think so, though I would not say they were definitely selected to be taxed for financial reasons but simply that their omission from the general tax was probably not considered.

A.2910. You have just issued a notification this month on dairy appliances?—Yes, we made some additions to them.

A.2911. Cheese presses have been omitted from that free list; I presume that is just an accident?—Yes.

A.2912. We have also had evidence that your department has such a soft corner in its heart for wild pigs that you have put a special revenue on wire netting of 15 per cent?—That is not a special duty; it is a general duty.

A.2913. That also is not policy; it is merely due to financial stringency?—The position with regard to steel is different from other items in the tariff; there was a specially low rate of duty on structural steel before the Tariff Board sat and considered the protection of the steel industry, and then they selected particular items for protection; but wire netting falls under neither of those heads; it was never given any special concession as structural steel, nor was it protected under the heavy protective duties; it remains under the general duty of 15 per cent.

A.2914. We have had a lot of complaints about the fumigation of plants; is that under you?—The actual fumigation process is carried out in the Customs Houses.

A.2915. The witnesses have complained of heavy losses?—I have had to enquire into complaints of this nature and I generally find it comes down to this that the damage is done not by the fumigation but by the packing and unpacking, for which the importer is responsible and not the Customs Houses; it generally is due to the fact that the importer has not made proper arrangements for packing and unpacking his own plants.

A.2916. *The Chairman:* In answer to Mr. Calvert you suggested that the absence of cheese presses from a list of dairying articles which have just been put on the free list may be a defect in that list. Apart from the merit of that particular case, would you submit a list of that sort to the Agricultural Department?—I think it is much more likely that the proposals would come from them. I can find out who did make those proposals, if you wish me to. I am sorry to say I have not the papers at the moment, but ordinarily a suggestion of that kind would probably come from the department interested in protecting a particular industry, and their list would probably be taken, subject to our being satisfied that they did not include a lot of things that were commonly used for other purposes.

A.2917. A slip of the sort suggested may occur at any moment?—Yes.

A.2918. Is there any difficulty in remedying the matter?—There are two ways of remedying it; one is to vary the tariff, which is ordinarily done only once a year by the legislature; the other is by the issue of a notification which the Government of India could do under their executive powers; that can be done at once and the concession can afterwards be embodied in the tariff at leisure.

A.2919. Is that by Order-in-Council?—No, it is by a notification by the Government of India; the Sea Customs Act empowers the Governor General in Council to exempt any particular class of goods from duty.

A.2920. A minor alteration of the kind in question could be made in that fashion without any delay or difficulty?—Yes.

A.2921. *Mr. Kamat :* On page 339 you say that the Commerce Department memorandum contains a list of the many concessions given to the agricultural industry, but of these it may be said that " they form a patchwork of individual ideas rather than a carefully thought-out and well-balanced scheme." So, the department is according to you conscious that, after all, the present tariff is a patchwork of individual ideas?—Perhaps, that is rather a tactless criticism of the Government I have the honour to serve, but what I rather intended to indicate was that most of these concessions have resulted from odd suggestions from time to time; the suggestions have been considered and put in, but there has never been, as far as I know, since the general tariff was re-imposed in 1894 any general enquiry as to how far we ought to go in regard to assistance to the agricultural industry and what concessions we ought to give them; no comprehensive scheme has ever been framed.

A.2922. You are conscious that now the time has arrived when a comprehensive list of concessions has to be worked out and put in a schedule?—Yes; I take it that was one of the objects of the Government of India in appointing this Commission.

A.2923. In this connection also have you ever felt another need: for instance, in fixing import duties on certain agricultural machinery the spirit of the Government of India is to give concessions in the interests of agriculture?—Yes.

A.2994. But in certain cases is the object of these concessions frustrated by the railway freights? For instance, the railway freight on sugar crushing mills is very heavy as they are classed as machinery? Whose function is it to see that your object in giving concessions is not frustrated by the railways?—I do not quite follow how the concession is frustrated.

A.2925. I mean you allow sugarcane crushing mills to be free of duty?—Yes, but that does not mean that they pay any heavier railway freights than they would if they paid duty.

A.2926. By reason of classification on the railways, however, sugar crushing mills, although they could be easily carried even in a brake van, are classed as heavy machinery and charged high freight. Is not that frustrating your good intentions?—I am afraid that is a matter for the Railway Department.

A.2927. I ask you whose function it is to see that the object of the Government of India is not frustrated by the railways by wrong classification?—" The Government of India in the Railway Department " I think is the answer to that.

A.2928. Does not the Commerce Department deal both with these tariff concessions as well as with railway matters?—To the Commerce Department has been assigned the subject? Tariffs, which overlaps very largely with the subject Customs, which has been assigned to the Finance Department and is dealt with by the Central Board of Revenue. But the Commerce Department does not deal with Railways. The Commerce Member has also charge of the Railway Department, but only to that extent does the Commerce Department deal with Railways. The Member has two departments under him; one is Commerce and the other is Railways.

A.2929. But if something is wrong in connection with railway matters, is it not his function to see to it?—It is the function of his department to deal with it; he may not personally deal with a particular case.

A.2930. Assuming the object in view in import tariff has to be co-ordinated with railway tariff and some one has to prevent a good object being frustrated, whose function is it to see to it? Cannot the Commerce Member do these things?—I do not quite follow; do you mean what are his powers over his own Railway Department?

A.2931. Certainly?—I suppose his powers are those of any Member of the Government of India over his own department.

A.2932. So that if the Commerce Department were to construct now a comprehensive scheme such as that to which you alluded in your first remarks to me, could the Commerce Member see to both these matters?—Are you trying to get at this: is there any advantage to be derived from the fact that the Commerce and Railway Departments are under the same Member? I think the answer to that is "No." I do not think the fact that the two departments are under the same Member affects the matter in the slightest.

A.2933. So that there is no hope of relief in that direction?—No particular hope in that direction, no.

A.2934. Speaking of the effect of export duties on agriculture, you have mentioned that the duty at present on rice is 3 annas a maund?—Yes.

A.2935. Have you heard any complaint that this duty is very heavy?—No, I believe it has been so for over 100 years.

A.2936. You have heard no complaints that it presses very heavily?—I do not remember hearing any.

A.2937. In the case of jute the present duty is Rs. 4-8 per bale?—Yes.

A.2938. Can you give me an idea whether jute could stand some enhancement of that duty?—I do not think the duty has reached such a height that the point of diminishing returns can be said to have been attained. But whether it is desirable to raise it any further is another matter.

A.2939. Similarly, there is a specific duty on sugar now of Rs. 4-8 per cwt.?—Yes.

A.2940. You say that is equivalent to an *ad valorem* duty of 37½ per cent?—Yes, at the present prices.

A.2941. Have you heard any complaints that it is a very high duty?—No serious complaints.

A.2942. Could not that stand a little enhancement?—Again the point of diminishing returns cannot be said to have been reached.

A.2943. *Sir Henry Lawrence:* On what price of sugar is that calculation of 37½ per cent made?—I base that on the import figures for last December.

A.2944. On the price that ruled last December?—Yes.

A.2945. I was told recently that it was about 25 per cent on present prices?—Possibly you are taking 25 per cent of the gross price. I think the present price of sugar is Rs. 18 to Rs. 19 duty paid at the ports. The 37½ per cent I have taken is the equivalent of Rs. 4-8 on about Rs. 13-8.

A.2946. That would be about 33 per cent?—Yes, taking a rough figure.

A.2947. Would you like to tell us anything about the complaints which have been made in the papers of the fact that sugar is being largely smuggled through free of duty that is through Kathiawar?—I should prefer not to discuss the matter unless the Commission wish to press it. Somewhat delicate negotiations with the Kathiawar State are in progress. We do realise we are losing a lot of duty and steps are being considered to stop it.

A.2948. Apart from the loss of your duty do you consider there is any injury to the cultivator from that importation?—I do not think there is any serious injury. It is true that duty-paid sugar is being under-sold to a small extent; but the difference in price is only just sufficient to enable it to be under-sold. At present, I think, they are finding a little difficulty in underselling.

A.2949. It does not depress the price of *gur*?—Not appreciably, I think.

A.2950. Have you considered that?—No. It would do so, of course, if it continued. Still, as I say, we are considering steps to put a stop to it.

A.2951. You are looking at it from the point of view of loss of revenue and not from that of the interest of the cultivator; that is not your affair?—We are looking at it also from the point of view of the interest of trade in other directions. I do not think we have considered the possibility of the price of sugar being depressed and thereby affecting the price of *gur*. The difference in price between sugar that comes through Kathiawar and sugar that pays duty in Bombay is small compared with the annual fluctuations in the price of sugar.

A.2952. Coming to the point Mr. Kamat raised about concessions for the importation of implements, you mentioned the necessity of having a well-balanced scheme. How do you suggest that such a scheme should be prepared?—Possibly this Commission might do something in that direction.

A.2953. It will require a good deal of working out by officers in this country, will it not?—Yes. I think the Agricultural Department might consider those agricultural implements which are on the free list and make as comprehensive a list as they can of articles which they consider should be added to that list. What happens at present is that all the recent additions to that list have been the result of the importation of some new American or British invention. The importer brings it in hoping to get it through as an agricultural implement exempt from duty and finds it is not on the list and that he has to pay duty. He makes a fuss and the question is examined and the decision comes to that it should be exempt; and so eventually another item is added to the list. That is the way the thing is done at present; but possibly when the Commission is in England they might collect a good deal of information as to types of agricultural implements which could be utilised in India. Nomenclature is rather difficult in that connection. If you look at the names of implements in this list you will see what I mean. There are things like " Cultivators " (I have never been quite sure what a " Cultivator " is), ensilage cutters, root cutters, and so on. There are various things still exempt by notification which may be added to the free-list in due course by legislation. It is always difficult to make a complete list of articles falling under a general definition and however big the list you cannot altogether avoid having several things which have been left out coming along later and claiming to be put in.

A.2954. Your suggestion is that the Agricultural Department should be called on to work out a detailed policy including, of course, the question of the free importation of seeds and plants and everything else that may be required to assist the cultivators in this country?—Yes. I think the initiative must come from them.

A.2955. *Sir Ganga Ram:* It has been represented to us by implement makers in this country that they cannot compete with foreign implements which are admitted free because those implements are made from raw materials which have paid no duty, whereas people who manufacture implements in this country have to use raw materials which have paid a high duty of 40 per cent or something like that?—Very often there is a high protective duty.

A.2956. What measures would you propose to mitigate that hardship?—It is one of the difficulties which always arises from a protective policy. Discrimination in favour of one industry is very apt to affect another adversely.

A.2957. Would you suggest anything in the way of a counter-rebate, or something like that?—As a Customs officer that is not a proposal I should like. It would be a very difficult proposal to work; it would be difficult to give a small manufacturer a thousand miles away from the port a rebate on steel he is using for manufacturing his implements.

A.2958. What are the latest orders with regard to your relations with Indian States? Do you give a rebate to them on everything they import?—No. A distinction must be made between Indian States having no sea frontier and those which have. As far as the former class is concerned, we do not give rebates except to Kashmir and Jammu, but States having a sea frontier are in a peculiar position and as far as they are concerned we have different arrangements with different States.

A.2959. Do you not think that smuggling may occur through such States?—I should think it is quite possible.

A.2960. How do you protect yourself against that?—As I told Sir Henry Lawrence, we are very much concerned at the moment about that particular danger and I should prefer not to discuss the steps we are proposing to take to stop it. However, we have the matter under consideration.

A.2961. Has your department considered any preferential arrangement by which you would charge more for imports from, say, Japan than for imports from England on chemical manures and things of that sort?—Not so far as I know.

A.2962. No preferential arrangements have yet been made?—No.

A.2963. In your list of manures you have not included sulphur. Do you charge full duty on that? That is the basis of all super-phosphates?—That is free of duty. It is not free as a manure but as a basis for manufactures.

A.2964. In the case of rice coming from Burma to Bengal is no duty charged?—No, neither an import nor an export duty.

A.2965. Does power-driven machinery for refining sugar come in as agricultural machinery?—In any case it only pays a duty of 2½ per cent.

2966. I want to know whether machinery imported for purposes of refining sugar is classed as agricultural machinery or not?—No, not sugar power machinery.

A.2967. Do you put a tariff on fencing, Canadian fencing for example, which is used to keep out wild animals?—Yes; 15 per cent. It is the ordinary general rate of duty.

A.2968. Would you not class that amongst agricultural requirements?—It is certainly not an agricultural implement. The agricultural implement is a free item and not the agricultural requirement.

A.2969. *Sir Thomas Middleton:* In connection with the importation of salt are there any preferential duties?—No.

A.2970. What is the duty on salt coming from Aden?—Rs. 1-4-0 a maund.

A.2971. That is the same as the internal duty?—Yes.

A.2972. In connection with the salt manufacture which is in private hands in Madras and Bombay, who maintains the bonded warehouses?—The Government maintain them.

A.2973. Has any change recently been made in the handling of salt manufacture in Bombay? You remember, I think, that the Indian Taxation Enquiry Committee made a reference to the fact that changes were required?—I have seen those papers and my recollection is that after going through the matter quite thoroughly we disagreed with the Taxation Enquiry Committee's recommendations and decided that the Bombay system was as good as, if not better than, the Madras system which the Committee recommended and we decided not to interfere with the former.

A.2974. So that the position remains exactly as it was before the report of the Salt Committee of 1902 which made similar recommendations?—Yes, the position in regard to certain matters such as the method of weighment and so on.

A.2975. *Sir Henry Lawrence:* Where does the imported salt now come from?—United Kingdom, Aden, Port Said, Hamburg, Liverpool, Spain.

A.2976. Is the majority of it Continental salt?—No; I can give you the last year's figures (1925-26): United Kingdom, 104,000 tons; Aden, 185,000 tons; Germany, 40,000 tons; Spain, 48,000 tons; Italian East Africa, 51,000 tons; Egypt, 118,000 tons; French Somaliland, 14,000 tons.

A.2977. Of that, which is sea salt and which is rock salt?—Salt from Aden and Port Said is certainly sea salt and I was under the impression that German salt and Spanish salt was also sea salt.

A.2978. So only the United Kingdom salt is rock salt?—Yes; I think so.

A.2979. In which part of India is the imported salt consumed?—In Bengal, Assam and Burma.

A.2980. Is there any importation of foreign salt into Bombay?—No.

A.2981. *Sir Thomas Middleton:* The salt which is produced in Bombay and Madras does not, I understand, meet the requirements of the consumers in Bengal, Assam and Burma?—They are very conservative buyers, I think.

A.2982. It is not merely a question of the cost of shipment?—I do not think so, no.

A.2983. It is a question of the quality of the salt?—We had a very large quantity about 2,000 tons, of Tuticorin salt lying in Chittagong for 3 years which the owner could not sell in order to pay his duty. We tried to see if we could sell it at less than the duty but there was absolutely no demand for it.

A.2984. *Sir Henry Lawrence:* It is a matter of taste?—Yes.

A.2985. *Dr. Hyder:* I understand you expressed the opinion (I was not here at that time) that the Central Board of Revenue has not accepted the recommendations of the Taxation Enquiry Committee. I suppose you refer to the arrangements for the supervision of the salt at Bombay?—Yes; I cannot claim very great intimacy with that particular matter, but my recollection is that in so far as the Taxation Enquiry Committee presided over by Sir Charles Todhunter recommended that we should substitute the Madras system for the Bombay system, we decided that we would not do that.

A.2986. May I, in reply, point out the fact that I know those salt *golas* in Bombay and I think your people in Bombay do not know how much salt there is; if I were so energetic, I could take one or two *golas* without your knowing anything about it?—Is that a fact?

A.2987. I know the Madras system is a little more elaborate and goes into details, but apart from that the Madras system is better in my opinion?—I say I do not take any personal responsibility for that decision.

A.2988. I think the Taxation Enquiry Committee also recommended that the tariff should be made subject to an examination by an expert body. Do you not think that the time is now come when the Tariff Board should go into the question of tariff item by item?—I do not think it is the business of the Tariff Board. The Tariff Board is merely there to consider giving discriminating protection to particular industries; it has nothing to do with the general tariff.

A.2889. There is no other body to consider that question in India and the only expert body the Government of India does possess is the Tariff Board?—Would you say that the Tariff Board is a body of experts in tariffs?

A.2990. I am inclined to say so. Do you think that the Commerce Department of the Government of India or the Central Board of Revenue are capable of subjecting the tariff to the minutest scrutiny?—I hope that any opinion that I may express may not be construed as committing the Government of India on the subject, but I should like to say that I do not think the Taxation Enquiry Committee made it particularly clear as regards the directions in which they wanted us to consider the revision of the tariff. We have had a great deal of criticism, and the question of revising the tariff is engaging the attention of the Government of India; but it is a matter which would be extremely difficult to deal with in this particular session with important items like the Steel Protection Bill and others coming on. Such an important measure which involves a complete revision of the tariff policy can hardly be taken up in this legislative session, but I think you may take it that the Government of India will consider, or rather are considering, what should be done in the matter; they realise that the present system is not a satisfactory one. One of the most unsatisfactory items, in my opinion, is the existence of this delightful document which I have here which has its items arranged in an entirely different order from the statutory tariff and is commonly regarded as "the" Indian tariff which it is not.

A.2991. *Mr. Kamat:* In this connection would it not be possible to appoint a committee of the legislature to revise or overhaul the whole thing by the end of the next session?—Do you think that the legislature could find a body of experts among themselves?

The Committee may include also members who have served on the Taxation Enquiry Committee, members who have served on the Tariff Board and so on?

A.2992. *Dr. Hyder:* I may say that the idea was that the whole subject should at one time be made over to the Tariff Board, with such additional members being added to it as the Government of India might think necessary?—I understand that the Tariff Board has already a big programme before them and I do not think this general revision concerns them, nor is it in any way related to the purpose for which they were appointed.

A.2993. Coming to the note of your evidence you say on page 339: "An alternative course would be to make all agricultural implements free without specifying any by name," and so on. What difficulty is there if all agricultural implements were made free without specifying any name?—From my point of view the Collectors of Customs would have to decide whether a particular instrument was or was not free and different Collectors might decide the same question in different ways. That is really a matter in which we try to please the trade and if you listen to what the Chambers of Commerce have to say on the subject they would prefer to have the articles definitely specified rather than included under a vague item. I am not prepared to say that it would be better from their point of view, but that is what they themselves say.

A.2994. Taking the case of hand rice-hullers, they are not definitely specified in the schedule and they are subject to duty. My point is this: You say that a body of case-law would grow up round the item and the Chambers say that the case-law is not available. Now take the case of your Income Tax Act. Round about that Act there has grown up a body of case-law, is not that so?—Yes, I suppose so.

A.2995. And you issue the rulings. Is there any difficulty there? Why should not the same procedure be followed in the case of agricultural implements?—I say the Associated Chambers have complained about it. I do not personally say that their complaint is a good one, but they have complained. I think it is for you to consider which you would rather have, certainty or uncertainty.

A.2996. What is your opinion?—As a Customs Officer I would rather have it specific. I should then not have to consult somebody as to whether a particular thing can be used for any other purpose.

A.2997. Is saltpetre imported free, or is it subject to any duty?—I said 15 per cent; we have already discussed that I think.

A.2998. What is the reason for saltpetre being subject to a duty of 15 per cent?—Because it has not been exempted from it. All articles not otherwise specified are subject to a duty of 15 per cent.

A.2999. Is that not specifically exempted?—As I have already stated before, it is very rarely imported and I do not suppose it has occurred to anybody to exempt it.

A.3000. The reason generally given is that it might be used for the manufacture of gunpowder; but surely its agricultural use predominates?—I think I quoted the figures: about 5 tons of saltpetre had been imported in five years so that could hardly be contended that it would have been prejudicial to the interests of the Government if it were put on the free list.

A.3001. The point in my mind is that there is no reason for the existence of this duty of 15 per cent on seedlings, plants and cuttings, because they might be used to improve agriculture?—The Commerce Department gave you, in their note, a list of the things which were free and all I tried to do here was to let you see exactly how far the concessions we at present give fall short of the concessions on all the things which could be conceivably used for agriculture; that is why I have merely mentioned one or two things here on which concessions are not given, not that it has been decided not to give concession but that probably it has not been considered. The concessions we have given have come up one by one and after having been considered they have been either put on the free list or rejected.

A.3002. Would you not like the Government of India in the Commerce or Finance Department to take the help of the Agricultural Adviser who would be in a better position to tell you whether a certain implement is for agricultural use or not?—It is our usual practice to consult him.

A.3003. Is this duty on sugar which works out to 37½ per cent protective or revenue?—Revenue.

A.3004. *Professor Gangulee:* Would you favour the idea of including scientific apparatus, such as microscopes, in your free list?—I think we might include particular scientific instruments. I think it would be rather dangerous merely to say that all scientific instruments should be free. If we did so we should be faced with a series of arguments as to what was and what was not a scientific instrument.

A.3005. For instance, scientific apparatus would be necessary to equip Government agricultural colleges or research stations and so on?—I do not think that the exemption of a limited number of particular items such as microscopes as suggested by you would seriously affect our revenues. But I do think that it would be dangerous to say that all scientific apparatus should be exempted. In that case Messrs. Tata and Sons, for example, might come forward and say that the whole of their plant consisted of scientific apparatus and ask for that to be passed free.

A.3006. When I suggested scientific apparatus I meant things which were utilised in the laboratories for experimental purposes?—Our difficulty would be to find a satisfactory definition.

A.3007. In putting the various agricultural implements and manures on your free list, do you know of any suggestions which came from the Agricultural Department, either Imperial or Provincial, in this matter?—Yes, I think some of them did come through them.

A.3008. Is it your practice to consult the Provincial or Imperial Agricultural Departments in these matters?—Yes. As I said the initiative is generally taken by the importer who, if he finds he has to pay a duty on a particular thing, applies to the Collector of Customs, and the latter after satisfying himself that the case is a genuine one, sends it on to the Government of India who in their turn consult the Agricultural Adviser.

A.3009. *The Chairman:* Could you let us hear whether cheese presses were excluded from the tariff schedule on the initiative of the Agricultural Department, or in consultation with them?—The Inspector-General of Agriculture on the 1st of February 1904 wrote to the Government of India thus: " I have the honour to suggest that dairy machinery of every description should be exempted from import duty for a very large trade in butter and milk products is developing. The industry affects the agricultural community. Cream separators are largely used in remote villages." Then he was consulted unofficially and he said in reply: " Many dairy appliances which are imported as such can be used for other purposes and it is unlikely that the Finance Department would allow the inclusion of such a thing in the free list. It is unnecessary perhaps to press for their inclusion as with native enterprise they could in many cases be made in the country. I send herewith a complete catalogue of dairy appliances and machinery which shows how great the variety is. We might press for including the following in the free list: Cream separators, milk sterilizing or pasteurising plant, milk refrigerators, churns, butter driers and butter workers." I do not know whether you have this list.

A.3010. *Mr. Calvert:* It was in 1907, was it not?—No, that was the addition of milking machines to the list.

A.3011. *The Chairman:* I wonder whether these additions were considered by the Agricultural Department?—Those six items were the last that the Inspector-General of Agriculture sent up; they did not include cheese presses and apparently no one has ever asked for cheese presses to be included since.

A.3012. In a case where your department took the initial steps would you automatically, as a matter of office routine, submit a suggestion of that sort to the Agricultural Adviser?—Yes, I think the Government of India would always consult him.

A.3013. *Sir Thomas Middleton:* You mentioned just now the case of the importation of Tuticorin salt which was unacceptable to the Bengali consumer. I think it is well-known that Bombay and Madras salt does not go into Bengal or Burma?—A certain amount of Bombay salt does go into Bengal but the salt is rather of a dirty brown colour.

A.3014. I was going to ask you whether you have any information about Northern India salt, does it go into Bengal?—Not very much I think.

A.3015. Is it because of the carriage or because of the quality?—I think probably it is both now. As I say the Bengali is conservative; he has got used to a particular class of salt and he does not like to change it, and I imagine also that the railway freight must be a serious consideration in this matter.

(The witness withdrew.)

The Commission then adjourned till 10 o'clock on Tuesday, the 22nd February 1927.

Tuesday, February 22, 1927,

DELHI.

PRESENT:

Sir HENRY STAVELEY LAWRENCE, K.C.S.I., I.C.S. (*Chairman*).

Sir THOMAS MIDDLETON, K.B.E., C.B.	Mr. H. CALVERT, C.I.E., I.C.S.
Rai Bahadur Sir GANGA RAM, KT., C.I.E., M.V.O.	Professor N. GANGULEE.
SIR JAMES MACKENNA, KT., C.I.E., I.C.S.	Dr. L. K. HYDER.
	Mr. B. S. KAMAT.

Mr. J. A. MADAN, I.C.S. } (*Joint Secretaries.*)
Mr. F. W. H. SMITH.

Dr. D. B. MEEK, M.A., D.Sc., O.B.E., Director General of Commercial Intelligence and Statistics.

Memorandum on Agricultural Statistics.

The most convenient starting point for a history of Agricultural Statistics in India is the despatch of the Secretary of State No. 25-R., dated 4th May 1882, with which were forwarded a set of agricultural tables compiled by the India Office, from the statistical information furnished in provincial land revenue returns and Administration Reports. The course of compilation had revealed the fact that greater uniformity in the method of compilation and greater accuracy were necessary, and the Government of India were asked to effect such changes in the forms as would enable information of a uniform character to be compiled for All-India. The matter was considered at a Statistical Conference held in 1883, and revised forms and instructions were issued to Local Governments and Administrations; it was also decided with the approval of the Secretary of State that the Revenue and Agriculture Department, one of whose duties had been defined to be "the more complete and systematic ascertaining and rendering available of the statistics of vital, agricultural and economic facts for every part of India, in order that Government and its officers may always be in possession of an adequate knowledge of the natural condition of the country, its population and its resources," should undertake the compilation and publication of these statistics. Accordingly, the Agricultural Tables relating to India were compiled and published for some years by that department. Other departments of the Government of India were also publishing statistics relating to subjects under their control, but it was soon felt that the disconnected manner in which Indian statistics were being compiled and issued by various departments of the Government of India seriously detracted from their value and that their intelligent examination, collation and interpretation were necessary to render them as useful as they might be. In 1895, a Statistical Bureau was therefore formed under an independent officer with the designation of Director General of Statistics; and the statistical work of the departments of the Government of India was entrusted to him. He was to compile and publish the statistics in his name and on his responsibility, but under the general guidance and control of the department concerned. This arrangement continued till 1905, when the Statistical Branch was merged in the new office of the Director General of Commercial Intelligence. After a few years it was felt that the two departments of Statistics and Commercial Intelligence could not, consistently with efficiency, be combined under a single officer. In 1914, a separate Department of Statistics was therefore created. But this separate arrangement was short-lived; in December 1922 the Department of Statistics was amalgamated with the Commercial Intelligence Department.

2. *Agricultural Statistics, Volume I.*—The statistics compiled by the India Office referred to above, briefly stated, dealt with the total area of each Province and district, the cultivated area and waste lands, the latter head being further sub-divided into culturable and unculturable, the area occupied by the principal crops in each Province and district, and the incidence of land revenue per head of population and per unit of cultivated area. The chief defects which were noticed at the time of compilation by the India Office were, firstly, that the figures under the same heading did not always mean the same thing in all the Provinces, and secondly that only a little more than two-thirds of British India was brought under the scope of the returns. To illustrate the first point, "cultivated area" in most Provinces correctly included areas under cultivation which were not assessed to land revenue, but some Provinces excluded such areas from the area under cultivation, and showed them under area unculturable, as information regarding those tracts was not available with the revenue agency. Again, in most Provinces "cultivated area" meant the area actually under the plough, but in others it included pasture, meadow, and fallow lands in occupation. The value of the statistics was seriously impaired also by the second main defect noticed, *viz.*, that the returns did not include all parts of even British India. Thus Bengal which has no revenue agency in each village was completely left out of the returns; the same was the case also with the permanently settled tracts of other Provinces, and with the area of the Indian States, both within and outside the British Provinces. The subsequent history of agricultural statistics in India is a record of the attempts made to introduce uniformity and comprehensiveness in the returns for each Province and to improve the manner of their compilation and presentation. The subject was discussed at various committees and conferences, but progress had to be slow, for the problem was limited by the varying requirements of the revenue systems obtaining in different Provinces. The provincial needs were obligatory, since the revenue system demanded that certain items should be kept separate or grouped together; the requirements of statistics had therefore to be limited by the exigencies of administrative convenience. The statistics are therefore a compromise between what is ideally desirable and what is actually attainable. The notes and appendices in the agricultural statistics volume indicate how far it has been possible to evolve a uniform system.

3. *Development.*—It would be unnecessary to trace the progress achieved till now in the improvement of these statistics except in the briefest manner. The forms now used in agricultural statistics are practically those prescribed in 1891; Appendix II shows the chief additions or changes made from time to time. The principal of these may be mentioned here for convenience. Beginning from the volume for 1894-95 the table on "Price of Produce" was discontinued, other arrangements having been made to secure a record of prices. From the volume for 1896-97 a summary table was introduced at the beginning showing the figures for British India relating to each table for a series of years. From 1901-02 the table on "Varieties of Tenure" was abolished. Beginning from the volume for 1912-13 the summary tables were expanded and a table on world crops added. A series of charts was also introduced from that time to illustrate the trend of the development of agriculture. With effect from 1919-20 the table on "Transfer of Land" was abolished, and a new table on "Harvest Prices" introduced; in addition

the table under "Classification of Area" was amplified and the area under "Irrigation" shown separately.

4. When the tables were first prescribed it was intended that they should be restricted to areas for which accurate returns were obtainable, *i.e.*, to areas which possess a field-to-field record and a village staff, the area for which no returns exist being eliminated by deduction from the total. The area shown under the latter head was not inconsiderable, and it was felt to be a serious defect in the statistics. The first exception to the above principle had to be made in the case of Bengal, which in the absence of survey and village staff, must otherwise have remained a total blank in the volume. The principle was therefore introduced of admitting estimates based on local enquiry and knowledge. There were, however, gaps still, and in 1906 the Government of India asked other Local Governments to follow for those tracts for which accurate information was not available, the system already adopted by Bengal. At present, therefore, we have complete statistics for the whole of British India based on actual measurements and supplemented by estimates. These estimates are improving in accuracy with the progress of cadastral surveys.

5. From the very outset figures for both Provinces and districts were shown in the tables. From the volume for 1921-22 the district figures have been abolished altogether as a measure of economy. The number of years for which figures were shown has varied from time to time. At present the provincial figures are confined to the last five years.

6. The period to which the returns of agricultural statistics referred was not for a long time the same in all cases. In some Provinces they referred to the financial year and in others to the agricultural or revenue year of the Provinces. In 1919 the returns were brought on to the same period for most of the Provinces, the year ending 30th June being adopted as the agricultural year. The exceptions are the Central Provinces and Assam, who prepare all their returns for the year ending 31st May and 31st March respectively, and Bombay, which prepares returns relating to the table on land revenue for the year ending 31st July.

7. *Agricultural Statistics, Vol. II.*—The earlier issues of Agricultural Satistics incorporated figures relating to such Indian States as furnished the reports. The statistics for the Mysore State were available from the very beginning. Gradually such other Indian States as had the requisite agency to collect the statistics began to supply figures regarding their States, and it was soon found necessary to deal with them in a separate section (Part II) of the volume. By 1904, the number of reporting States had sufficiently increased to justify a separate publication regarding Indian States, styled Agricultural Statistics, Volume II. Efforts have been made at various times to increase the number of reporting States, but the returns are purely voluntary, and there is still a considerable area which is not included in the publication. The statistics are also far less accurate and complete than those of British Provinces.

8. *General.*—The statistics of area as far as British Provinces are concerned are, on the whole, fairly accurate, and there is little scope for improvement. In most of the Provinces there exist a field-to-field record and a village staff, capable of reporting the area under crop with great accuracy. For permanently settled tracts, however, (Bengal, Bihar and Orissa, parts of Madras, the United Provinces and Assam) where the figures are based on estimates, and not measurements, the statistics are not as reliable. Another source of error in the area figures is the practice of mixing two or more crops in the same field; the respective areas under different crops have, in such cases, to be based on estimates.

9. *Livestock.*—The collection of statistics regarding livestock was undertaken at the instance of the Secretary of State. The forms in which they were to be furnished were laid down at the Statistical Conference of 1883, and these statistics have been regularly published in Volume I of the Agricultural Statistics. They are now based only on the results of annual or

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quinquennial censuses, but when they were started, there was the same difficulty regarding permanently-settled tracts as in the case of area statistics, *viz.*, the absence of an agency to collect the figures. Even in Provinces which possessed the necessary organisation the statistics were far from accurate as in some cases a census was completed only within the course of three or four years. Nor were the methods of enumeration free from defects. Some Provinces again took an annual census while others had a quinquennial census. The livestock figures of Bengal had to be estimated till 1912-13 when the Province took its first cattle census. In Bihar and Orissa a census was taken in 1913-14. But still the methods of collecting the data were not uniform, nor were they collected at the same time for all the Provinces. In 1916, the Government of India after consulting Local Governments and Administrations decided that a general census of cattle should be taken throughout British India between December 1919 and April 1920, and that this census should be repeated quinquennially. The co-operation of Indian States was also invited and several States took part. The results were published in a pamphlet form in 1921. From 1919-20, therefore, the statistics can be regarded as more satisfactory, but, except in the case of Provinces which take an annual census, the figures have to be repeated till the census is taken again at the end of the quinquennium. At present the Central Provinces, Manpur* and Burma take the census annually. The second census has taken place in all the Provinces but not at the same time, as Bengal, had, owing to financial stringency, to postpone it till 1926, while, on the other hand, the Punjab carried it out before the end of the quinquennium. A larger number of Indian States took part in the second census.

10. *Tea Statistics.*—Special Statements regarding tea, coffee, cinchona and cotton cultivation in British India and Indian States used to be compiled by the Department of Finance and Commerce and published in the volume "Statistical Tables relating to British India." The statistics of the production of tea which related to the calendar year were obtained from the owners and managers of tea estates through the district officers in forms prescribed for the purpose. The method of collection is at present the same but considerable improvements have been effected in these statistics through the help of non-official bodies like the Indian Tea Association and the United Planters' Association of Southern India. Where no reports are received from estates, estimates are made by local officers but before accepting these estimates this department makes a further attempt to obtain the actual returns by direct correspondence with the non-reporting estates and in many cases, with successful results.

11. *Coffee Statistics.*—The early history of these statistics is the same as that of tea. The methods of collecting the information are also the same. Originally the statistics related to the calendar year but in 1909 it was decided that these statistics should be prepared for the year ending 30th June which corresponds fairly closely to the coffee year. The change took effect from the statistics for 1908-09 which were issued in 1910. There were no issues for the years 1910-11 to 1918-19 as it was felt that the information supplied was very inaccurate. The statistics have been renewed with effect from 1919-20 in a slightly improved form. They cannot even at present be said to be very satisfactory and much improvement is possible in the accuracy of these statistics. As a record of total production of coffee in India they are defective in that they do not include plantations of less than 10 acres.

12. *Rubber Statistics.*—The first statement regarding rubber production published by this department related to the year 1919. The form and the methods of collection are practically the same as in the case of tea and coffee.

Tea, Coffee and Rubber statistics now appear as supplements to the *Indian Trade Journal.*

13. *Quinquennial Report on the Average Yield of Principal Crops.*—A provisional report on the yield per acre of the principal crops cultivated in

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* Manpur parghana.

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India was first compiled in 1892 from various statistical publications available at the time, such as Agricultural and Settlement Reports, Crop Forecasts, Gazetteers, replies to the enquiries of the Famine Commission, etc. It was decided that these estimates should be revised periodically and for this purpose a system of experimental crop cuttings was prescribed. These experiments are the basis, though not in every case the sole basis, of the revision of the standard estimates. The instructions for the preparation of these returns are that the estimates given should be that of the average outturn on average soil in a year of average character as deduced from considerations of the information obtained or experiments made during the period under review; so that the estimate of the average yield multiplied by the area might give an approximation to the total yield of crop in an average year. The results of the revision of the estimates are published at the end of every five years. If during the period under review, there were exceptionally good or bad seasons, the fact would not necessarily affect the standard estimates unless there are reasons for believing that the figures previously adopted as estimates of average yield in an average year were fixed either too high or too low. The chief object of quinquennial reports is not so much to show the outturn per acre during the particular period as to help in arriving at what may reasonably be considered as a normal outturn in a year of average crop. Separate estimates of yield are generally maintained for irrigated and unirrigated tracts. The average yield in each district as well as for the Province, is given in the publication.

14. Crop cutting experiments have till lately been made generally by the District Revenue staff. In 1913, on an examination of the reports of the quinquennium ending 1911-12, it was recognised that the results of the experiments as conducted by the district revenue staff were generally unreliable. A change was accordingly made in 1915 and instructions were issued by the Government of India, to employ, as far as possible, expert officers of the Agricultural Department in the conduct of these experiments. The new system was introduced in the quinquennium beginning 1916-17 mainly as an experimental measure, but in the majority of provinces the change could not be fully carried out, principally owing to insufficiency of staff in the Provincial Agricultural Departments. These experiments, if they are to yield reliable results, should be carried out in larger numbers and under the supervision of trained officers of the Agricultural Department.

15. *Crop Forecasts.*—The Statistical Conference of 1883, referred to previously, also discussed the question of issuing crop forecasts for the information of the public. They recommended that the Agricultural Departments should endeavour to give the public an early forecast of harvest prospects of crops of commercial value. The Government of India accepted these views and commended the proposal to the consideration of the Local Governments and Administrations. About the same time the Secretary of State, at the instance of a leading Liverpool firm interested in the wheat trade, recommended the publication of information regarding crops in India somewhat on the lines adopted by the United States of America Department of Agriculture. Accordingly in 1884 the Government of India issued a circular letter to Local Governments and Administrations requesting the preparation of forecasts of the wheat crop. It was also stated in the circular that the experience gained in attempting to secure continuous information as to the character of the wheat crop would lead the Directors of Agriculture to formulate and perfect a system applicable to other crops of commercial importance. In the following year, after considering the views of Local Governments, the Government of India issued orders to the Provinces concerned, to extend the forecasts to cotton, oil-seeds, rice and jute on the system adopted for wheat. Detailed instructions regarding the preparation of forecasts were also issued in continuation. This was the beginning of crop forecasting in India. At present forecasts are issued for the following crops —cotton, jute, wheat, rice, sugarcane, winter oil-seeds (rape and mustard and linseed) sesamum, ground-nut, castor and indigo. Of these the jute forecasts

are now issued by the Director of Agriculture, Bengal, and the method of estimating the outturn is also not the same as in the case of other crops.

16. The framing of an estimate of the outturn of a crop depends on three factors:—the area, the standard normal outturn per acre, and the condition estimate.

(*i*) *Area.*—As regards area it has already been noticed that in villages of most Provinces there exists an agency capable of reporting the acreage of crops with accuracy wherever fields have been mapped and surveyed. In respect of permanently settled tracts and areas under mixed crops, the statistics are not as reliable.

(*ii*) The second factor is the normal outturn per acre. It has already been noticed that the department entrusted with crop forecasting work in each Province maintains a record showing the average yield per acre of principal crops based mainly on the results of crop cutting experiments.

(*iii*) The third factor is the condition estimate, *i.e.*, the fraction representing the relation of the crop reported on to the normal crop per acre. This estimate is in the first instance framed by the Village Accountant or *Patwari*, as he is called or an official of similar standing by means of "anna notation," *i.e.*, the condition of crop is estimated to be so many annas higher or lower than the normal crop. The anna notation, however, does not follow a uniform standard in all parts of India for, in certain tracts 12 annas may represent a normal crop while in another 16 annas may represent the normal. Owing to this diversity of practice in different tracts it was considered advisable to use the American system in the published forecasts under which 100 denotes the normal yield. The *Patwaris*, however, are allowed to follow their own method as it is considered that the introduction of a new system will only confuse the estimates made by them, but the anna notation is converted into a percentage estimate according to the American system either by the district officers or by the provincial forecasting authority.

17. It will be seen from the above that the total yield of a crop is estimated by multiplying the three factors—the area, the condition estimate and the standard yield. Of these factors only the area figures can be regarded as fairly accurate. It has been recognised that there is often a not altogether negligible margin of error in the estimates of the condition and the standard yield. Even a very small error in either of these two factors would put the total estimates of yield far out inasmuch as the small error is multiplied by the area which is a large figure. The defects of the standard yield have already been noticed. The condition estimate is, in the first instance, prepared by the *Patwari* or village official who, being generally untrained and pessimistic by nature, is hardly able to form a correct estimate of outturn in terms of the normal crop. His idea of a normal crop is, that which he longs to see but rarely sees and the result is that the standard with which he compares a crop is really something above the normal. Consequently his estimates generally fall below the mark.

18. The Board of Agriculture at a meeting held in 1919 suggested that at the end of each season the "actual" outturn of crops should be determined by the collection and detailed study of statistics of movement by rail or sea, of manufacture, or of any process such as baling, and of estimates of local consumption. The average of the actual outturn thus obtained for a series of years divided by the corresponding area should represent the standard yield on which calculations should be made. As regards the condition estimate the *Patwaris* should be left to follow their traditional policy, but their estimates should be corrected in the light of past experience. Thus if the *Patwaris* reported during the last 10 years—

2—8 anna crops,
2—9 anna crops,
2—10 anna crops,
2—11 anna crops, and
2—12 anna crops,

it is a fair inference that when he sees an average crop he calls it a 10 anna crop and that when he reports a 11 anna crop, the crop is a little above the average. The *Patwari's* estimate should, therefore, be corrected in the light of a more correct conception of the normal. This correction of condition estimate can be done without difficulty. The standard yield however cannot be calculated, as suggested, for the simple reason that the determination of actual yield is beset with great difficulties. It would be difficult to estimate the amount of consumption or stocks, and the difficulty is greater in the case of food-crops than of non-food crops. In the case of cotton an attempt is made to determine the actual production by adding together the exports, the amount consumed in mills, and a conventional estimate of local consumption. The quantity of cotton consumed in Mills in British India is calculated from the amount realised under the Cotton Cess Act while for Indian States an estimate is made based on the quantity of goods produced in mills in such States. We have also returns of cotton pressed in British India and these returns, which are compulsory under the Cotton Ginning and Pressing Factories Act, are compiled and published weekly in the *Indian Trade Journal.* If these figures could be supplemented by the figures of loose cotton received in spinning mills, an estimate of actual production could be made, but there are at present no means of ascertaining the latter figures while the absence of information about Indian States would be another difficulty. In the case of other crops there is not even as much data to go on, and trade figures, without reliable figures of consumption, will not therefore serve the purpose of ascertaining the total yield. The Indian Sugar Committee, 1920, were definitely of opinion that the method is not applicable in the case of sugarcane and the Board of Agriculture while reviewing the subject again in 1924 emphasised the fact that crop cutting experiments must remain the basis of the standard outturn.

19. *The manner of publishing Forecasts.*—The general practice is to issue a preliminary forecast, a second estimate and a third or final estimate, fuller and more precise in data than the first two forecasts, as in the case of rice, oil-seeds and sugarcane. There are two additional forecasts for wheat and cotton and one for sesamum. On the other hand, only two forecasts are made of the jute, ground-nut and indigo crops and only one of the castor crop. The provincial forecasts are published as soon as they are ready by the department entrusted with the work, but advance copies are usually sent to this department for the purpose of preparing the All-India Memorandum. It often happens that the All-India forecasts are not ready for issue owing to non-receipt of some of the provincial returns and in such cases, the provincial returns are published in advance in the *Indian Trade Journal.*

Besides regular forecasts, monthly intermediate crop reports have been introduced from 1925, to be issued in the interval between the forecasts. These reports are mainly based on the expert opinions of provincial authorities and give no details but confine themselves generally to the effect of the season on the estimate of the condition of the crop since the last regular forecast. These reports are published in the *Indian Trade Journal* as soon as they are received from each provincial authority.

20. *Estimates of Area and Yield of the Principal Crops in India.*—This publication is mainly a summary of the forecasts issued during the year in a connected and convenient form. The history of this publication is therefore the same as that of crop forecasts. It is being published as a Blue Book. Its object is to show as soon as possible the best estimate available of the outturn of the principal crops during each season with general remarks about the character of the season. The latest year's figures given in the publication are provisional while the preceding year's are the corrected estimates. Owing to the difference in the methods of preparation of this volume, and that of Agricultural Statistics, the area under the same crop for the same year reported in the two publications have not always agreed. A detailed examination of the causes of discrepancy was made in the Department of Statistics and instructions were issued to local authorities to reconcile the

two sets of figures in future. Discrepancies however still continue to occur and the Indian Sugar Committee while reviewing the Agricultural Statistics pointed out this defect.

21. In the foregoing sections the publications on agricultural statistics issued by this department have been reviewed. The difficulties experienced in collecting the statistics have also been incidentally noticed. In the case of Agricultural Statistics, it has been observed that, so far as British Provinces are concerned, the area statistics are fairly reliable except in the case of tracts which have no revenue agency to report the statistics; the progress of the cadastral survey in these tracts has materially helped the district authorities to improve their estimates, but so long as the figures are based on conjecture, they cannot be as accurate as the statistics obtained from actual measurement. The practice of mixing different crops in the same field is another source of inaccuracy, the estimation of separate areas under each crop being based on formulæ adopted by each Provincial Government. In the case of Indian States the statistics are neither complete nor do they appear to be very accurate; and any improvement is conditioned by their willingness or ability to furnish reliable statistics. Some States make a serious effort to improve the statistics, but many have not got the requisite agency to collect them. The statistics relating to tea, coffee and rubber are obtained from the plantations, and both their completeness and accuracy must depend on the co-operation received from the managers of estates. The figures regarding tea are believed to be much more reliable than those relating to coffee. The statistics for coffee are also less complete inasmuch as they do not include the figures relating to small plantations. It has also been noticed that the "standard yield" of crops on which estimates of production are based are defective as the crop-cutting experiments on which they are mainly based have not been conducted either in sufficient numbers or with sufficient care. The limitations of our crop forecasts have been fully dealt with above; the principal lines along which improvements could be effected would appear to be (1) by a careful interpretation of the estimates of the condition of crops reported by the primary reporting agency, and (2) by the attainment of greater accuracy in the estimates of the "standard yield."

22. The publications on agricultural statistics serve a two-fold purpose. They are primarily meant for the information of Government, for no Government can afford to be ignorant of its agricultural resources, and secondarily they are meant for the information of the trade and the public. The trade is naturally more interested in forecasts of production than in the statistics of actual area or estimated production published long after the harvest is realised, for it is of the utmost importance to the trade to obtain a reasonably correct estimate beforehand of the quantity of agricultural produce it will have to handle. The chief, if not the only, use of the volumes of Agricultural Statistics is as a work of reference, showing the progress of cultivation in the country. They do not enable an estimate of total agricultural production to be made, for the area is not separately specified for all the minor or the unimportant crops, nor have standard yields from which production in an average year can be worked out been estimated for them. The estimated production of the principal crops alone for each year is given in the Estimates of Area and Yield.

23. The chief feature revealed by a study of the development of agricultural statistics in India is the fact that there has been no separate agency for collecting the statistics as such, and that the work has, from the beginning, been mainly performed by the revenue agency which was already collecting statistical information for their own purposes. This dependence on the revenue agency has obviated the necessity for any separate agency, and it is extremely doubtful whether a separate organisation could have been created in a country like India owing to the enormous expense of the undertaking. But, as already noticed, this association with the revenue system has sometimes stood in the way of strict uniformity. The policy of the

Government of India has all along been to interfere as little as possible with provincial revenue arrangements consistent with the minimum requirements of statistics and no departure from this policy is perhaps at present possible or advisable. The direction in which much could be done in the way of co-ordination and uniformity without interfering greatly with the revenue arrangements, is in crop forecasting. The work of submitting estimates of outturn is now being carried out in most of the Provinces by the Departments of Agriculture, though the raw material on which they are based continue to be supplied to a great exent by the revenue staff. The Agricultural Departments, however, are unable, in many cases, through paucity of staff, to devote as much attention to the subject as is necessary and the question turns primarily on finance. But it would be desirable if the experience gained in different Provinces could be compared periodically so that suggestions for improvement could be laid before Provincial Governments to be adopted so far as provincial conditions permit. The conditions affecting a crop or its outturn is as much a matter of All-India as of provincial importance; and the All-India figures can gain in accuracy only if all the Provinces fall into line as regards improvement in the methods of forecasting.

24. *Staff.*—The section dealing with Agricultural Statistics consists at present of seven men, but of these only five are exclusively engaged on Agricultural Statistics. One man is engaged on the cotton press returns, and the other is attached to the section only for 8 months in the year. The section is in charge of a Superintendent, who, however, has other branches as well to supervise. Two of the clerks are on the scale of 100—10—200 and the others on Rs. 50—3—125. The total average cost of staff, excluding supervising staff, is nearly Rs. 11,000.

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APPENDIX I.

List of Agricultural Publications with the nature of information contained in each.

Publications.	Nature of information.
1. Agricultural Statistics of India (Annual), Volume I.	Total area (in acres), classification of the area (in acres), area irrigated and crops irrigated, area under crops and specification of crops, livestock, ploughs and carts; land revenue assessment on the area, and population, harvest price of certain important crops, average yield (lbs. per acre) of principal crops in each Province of British India and Mysore in the form of appendix.
2. Agricultural Statistics of India (Annual), Volume II.	Relates to Indian States.
3. Summary tables of Agricultural Statistics (British India).	This is now issued as a supplement to the *Indian Trade Journal* published in advance of Volume I of Agricultural Statistics. Deals with all the main heads contained in Volume I except those relating to livestock, land revenue and harvest prices.
4. Report on the Census of livestock, ploughs and carts in India (Quinquennial).	Number of livestock, etc., in India as ascertained by census held quinquennially (started from 1919-20) together with comparative figures for foreign countries.
5. (*i*) Indian Tea Statistics . (*ii*) Indian Coffee Statistics. (*iii*) Indian Rubber Statistics.	These publications are now issued annually as supplements to the *Indian Trade Journal.* The information contained in them is of the following nature:—number and area of plantations, production (in lbs.) of manufactured tea, of cured coffee and of dry rubber; labour employed in all three industries; trade figures. Besides the above the following are given:—stock of dry rubber (in lbs.), quantity of tea available for consumption in India, prices, freight, duty, cess, capital and wages, etc., relating to the tea industry.
6. Quinquennial Report on the average yield per acre of principal crops in India (Quinquennial).	Average yield (lbs. per acre) of principal crops irrigated and unirrigated—in each Province and district of British India and in Mysore.

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Publications.	Nature of information.
Crop Forecasts.	
7. All-India (29 in number) Provincial Forecast. Intermediate reports.	Published in the *Indian Trade Journal.* Deals mainly with area, weather conditions affecting the growth of crops, estimates of outturn, etc. Information regarding crops of foreign countries also appended.
8. Estimates of Area and Yield of the Principal Crops in India (Annual).	Area, total yield and yield per acre of principal crops during the year and for the previous nine years, standard or normal yields per acre of crops for which forecasts are prepared. Area and yield of certain principal crops in foreign countries; normal and actual rainfall (in inches) in each meteorological sub-division in India, Charts, etc.
9. Weekly Cotton Press Returns	Statement of Cotton pressed in different Provinces in British India published weekly in the *Indian Trade Journal.*
10. Crop Atlas of India . .	This is an occasional publication and contains sixteen maps showing the distribution of principal crops, *viz.*, rice, wheat, barley, *jowar*, *bajra*, sugarcane, tea, coffee, tobacco, cotton, jute, linseed, rape and mustard, sesamum, ground-nut and indigo in different districts of India based on statistics of area. The average area and production of each Province and important ports of shipment have also been indicated with percentage share of the ports.

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APPENDIX II.

Statement showing the changes made from time to time in the forms of Agricultural Statistics.

1866.	1884.	1891.	1910.
IA. I.—Area cultivated and uncultivated.	A.—Area cultivated and uncultivated irrigation.	A. A (1) Total acreage.	I.—Total acreage.
		A (2) Classification of area including irrigation).	II.—Classifiation of area.
			III.—Area under irrigation and crops irrigated.
IIID. 1.—Crops, cultivated	B.—Crops cultivated.	A (3) Area under crops.	IV.—Area under crops.
IIID. 2.—Agricultural stock	IIID. 2.—Agricultural stock.	A (4) Agricultural stock.	V.—Livestock.
IIIE. 1.—Prices of produce.	IIIE. 1.—Prices of produce.	B.—Prices of produce (Discontinued from 1894-95).	VII.—Harvest prices.
IE. 2.—Surveyed and assessed area.	C.—Surveyed and assessed area.	C.—Incidence of land revenue on area and population.	VI.—Incidence of land revenue on area and population.
IE. 3.—Varieties of tenure held direct from Government.	IE. 3.—Varieties of tenure held direct from Government.	D.—Varieties of tenure held direct from Government.	Discontinued from 1901-02.
IE. 4.—Varieties of tenure not held direct from Government.	(Discontinued.)	(Discontinued.)	(Discontinued.)
IE. 5.—Register of transfers.	IE. 5.—Register of transfers.	E.—Register of transfers of landed property.	(Discontinued.)
IIID. 3.—Rates of rent and produce.	(Discontinued.)	(Discontinued.)	(Discontinued.)

Replies to the Questionnaire.

QUESTION I.—RESEARCH.—The general problem of agricultural development in India is the raising of the standard of efficiency of production from the soil and the standard of quality in the livestock of the country. These involve first research work under Indian conditions, and second, application of the results of research to actual production. If the research work is going to be other than dangerous it must be carried out by men who are highly qualified and who are specialists in each particular line. It further involves expensive equipment and in view of the great number of problems requires a large staff of workers. The expense involved in such research work eliminates the possibility of its being carried on efficiently by each Provincial Government. The research work should, therefore, in my opinion, be coordinated and carried out by staff directly under the Government of India a staff which should be freed from the executive action of demonstration and propaganda for the purpose of applying the results of research. The executive functions demand the location of the officers concerned in each Province and prolonged work in one part of India. The application of the results of research does not involve such a high standard of technical training and with the separation of the executive functions from the research work the former should remain with the Local Government. As to financing research an increase in the efficiency of production will enable an increase in the general revenue to be made but in the first instance there must be found means of increasing the efficiency. As an example of one method of obtaining finance the following may be given.

An export cess on hides and skins may be taken as a source of finance for veterinary research with a view to improvement of cattle, this research being done under the Government of India. Application of the results of this research and supervision of flaying and propaganda throughout the Province with regard to flaying and curing of hides, being executive functions should be placed under Local Governments. The application of cesses for the general purpose of finding finance for agricultural and veterinary developments might with advantage be extended.

The following are some of the more important cesses in existence:—

(1) Tea cess (Indian Tea Cess Act, IX of 1903.) A cess of six annas per 100 lbs. is levied on all tea produced in India and exported from British India. The cess is collected by Government and paid to the Tea Cess Committee after deduction of expenses for collection.

(2) Jute cess. (Bengal Act V of 1911.) A custom duty is levied on raw jute other than cuttings and rejections at the rate of two annas per bale of 400 lbs. and twelve annas per ton of 2,240 lbs. of manufactured jute. The duty is collected by Government and paid to the Calcutta Improvement Trust.

(3) Lac cess. (Indian Lac Cess Act, 1921.) A cess is levied on lac and refuse lac produced in India and exported from British India, the rate being four annas per maund for lac and two annas per maund for refuse lac. The cess is collected by Government and paid to the Indian Lac Association for research after deduction of expenses for collection.

(4) Cotton cess. (Indian Cotton Cess Act, XIV of 1923). A cess of two annas per standard bale of 400 lbs. and six pies per 100 lbs. for unbaled cotton are levied on all cotton produced in India and either exported from British India or used in any mill in British India. The cess is collected by Government and paid to the Indian Central Cotton Committee.

The work of the Tea Cess Committee, financed by a cess on tea, has been successful, tea production being highly organised and under more or less

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immediate control, that is, the crop at any time can be modified by the joint action of the organised growers. Part of the jute cess is used for purposes other than the development of agricultural efficiency, *e.g.*, a portion of it goes to the revenue of the Calcutta Improvement Trust. The lac cess is devoted to research work in connection with lac, but in this case the industry is by no means highly organised. The work of the Indian Central Cotton Committee is financed from a cess on cotton, and it performs functions of a highly beneficent nature to the cotton producers. Wherever possible, revenue derived from agricultural produce might reasonably be allotted, at least in part, to financing agricultural research and demonstration.

QUESTION 4.—ADMINISTRATION (*c*) (*iii*)—*Roads.*—India like some other Asiatic countries may be divided into two parts, Interior India and Exterior India, Exterior India being that portion of the country which is served by railways, Interior India being those parts remote from any railway line. It seems fairly well established that railway transportation is much more efficient and cheaper than road transportation, but extension of roads feeding the railway lines would presumably enable the cultivator at some distance from the railway to obtain higher prices for his produce and enable him to adopt methods which would tend to increase the production from his land. The extension and improvement of roads from railway stations into the interior will probably result in the introduction of a more efficient method of transportation of agricultural produce than at present exists.

QUESTION 10.—FERTILISERS.—In the case of tea, the Indian Tea Cess Association popularised the use of tea in India by providing it for consumption throughout the country at a cost which was frequently below production. A similar method might be utilised for the popularisation of new and improved fertilisers, the Agricultural Department of the Local Government being used as the agency for the distribution at cost price or even at a price slightly below cost. This, of course, involves a financial responsibility which might be met from funds obtained in a manner somewhat similar to that in which the activities of the Indian Tea Cess Association are financed.

QUESTION 14—IMPLEMENTS.—One of the difficulties which manufacturers have to contend with at present in their efforts to sell agricultural implements throughout the country is the scattered demand for such implements. The number of orders forthcoming is not sufficiently large to justify manufacturers in entertaining a staff in the mofussil. The sale of agricultural implements therefore on a hire purchase system direct by manufacturers has not met with much success. This is a direction in which it should be possible for Local Governments to come to the assistance of both the cultivator and the manufacturer. If an arrangement could be arrived at between the Government and the manufacturer whereby Government would be responsible for the collection of instalments by means of its organisation it seems probable that the sale of agricultural implements would extend in India. State aid to the cultivator in the form of hire purchase legislation for the purchase of machinery or even of fertilisers seems feasible.

QUESTION 26.—STATISTICS.—A note has already been submitted to the Commission on questions of Agricultural Statistics in India. I have only one suggestion to make under this head and that relates to the revival of the Rail-borne Trade Statistics. The Board of Agriculture in 1924 recommended —"That the compilation of rail-borne trade statistics should be revived, as these statistics provide for many crops a most important check on the estimates of production." Forecasts of production now depend on three factors: area, condition factor and standard yield. Changes in the standard yield can only be made as a result of crop cutting experiments, but the condition factor can be corrected in the light of trade statistics. The necessity for these figures of rail-borne trade is all the greater with regard to Indian States where forecasting is much less accurate than in British Provinces. Besides acting as a corrective to crop forecasts these statistics will be an index to agricultural prosperity to some extent.

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Oral Evidence.

A.3016. *Sir Henry Lawrence:* Dr. Meek, you are the Director General of Commercial Intelligence. Are you also in charge of statistics?—Yes.

A.3017. How long have you held your present office, and what was your official experience in India prior to occupying it?—I came to India in February 1911 as Professor of Physics, Dacca University; I was in the Indian Educational Service. I became Director of Industries in 1920 and in April 1926 I became Director General of Commercial Intelligence.

A.3018. What is the principal point which you wish to bring to the attention of the Commission? Is there any considerable improvement in statistics that you have been advocating?—No, there is no particular point as far as agricultural statistics are concerned. I have submitted a note* to Dr. Clouston for the Commission on the history and preparation of agricultural statistics.

A.3019. Then you are satisfied with the condition of the agricultural statistics as they stand now?—In that note, copies of which I see members have before them, I have indicated one or two points where in my opinion improvement might be made.

A.3020. Would you indicate them, very briefly?—These agricultural statistics depend, as far as forecasting is concerned, on three factors: the acreage, the standard yield and the condition of the crop. The acreage factor is fairly accurate; the standard yield is one of the factors which could probably be improved. The condition of the crop is not so accurate, perhaps, as the standard yield. These two factors, the standard yield and the condition of the crop, are the two factors which could yield better results if they were improved.

A.3021. Is the acreage accurate in a Province such as Bengal?—I have explained in my note that it is more or less an estimate, but it is improving. Where you have permanent settlement, the acreage figure is not so accurate as it is in some of the other Provinces.

A.3022. Have you a reporting agency over the greater part of the Indian States? Do the statistics of acreage include the Indian States?—Not all the Indian States; but most Indian States report to us statistics of acreage.

A.3023. What proportion of them report to you satisfactory figures?—About 56 per cent. of the total area of Indian States are reported on in agricultural statistics.

A.3024. If you wish to know the total yield of cotton, of which a fair proportion is grown in the Indian States, can you get (within a reasonable margin of error) what the total yield will be?—Yes, cotton statistics are fairly accurate. We have a check on them from the figures of baling we get and from export figures and consumption figures.

A.3025. Through what agency do the baling presses report?—Through provincial officers such as Directors of Agriculture, Directors of Industries, Chief Inspectors of Factories, etc.

A.3026. Every ginning press?—Yes, through above-mentioned officers.

A.3027. In Indian States as well as British India?—No, not in all Indian States. Five Indian States are furnishing press returns.

A.3028. In British India is that duty imposed upon them?—Yes, by the Act of 1925.

A.3029. Is there any particular action you wish the Government of India to take for the improvement of the statistics in connection with any of the three points you mention?—I do not wish to put forward any proposals at present. Nos. 2 and 3 will improve as time goes on.

A.3030. The condition of the crop in a particular area is reported by *Patwaris* and officers of that character. Is there a general tendency on their part to over-estimate or under-estimate?—We have a feeling that there is a general tendency towards under-estimation. I have stated that in my note. The general estimate seems to be always rather pessimistic, and instead of taking a percentage of what we call the normal crop, we feel they take a percentage of what they would like the crop to be.

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* *Vide* Pages 353-364.

A.3031. A percentage of the optimum rather than the normal?—Yes.

A.3032. Do you deal with forecasts?—We publish forecasts.

A.3033. Do you correct the estimates that come to you by any formula?—No, we simply publish the material which is supplied to us.

A.3034. By the Director of Agriculture?—Yes and other officers. We simply compile the figures and publish them. We publish provincial forecasts as well as forecasts for the whole of India.

A.3035. Do you rely on the Director of Agriculture to level up these original estimates which you regard as too low?—Yes.

A.3036. Does that process go on in the office of the Director of Agriculture?—Yes.

A.3037. When they reach you, do you think they are fairly accurate?—Yes, fairly accurate.

A.3038. Not markedly too low or too high?—Considering the agency by which the original material is obtained, I think they are fairly accurate. If we think an estimate appears to be far out we draw the attention of the Director of Agriculture to it.

A.3039. Are there any complaints made by any trades asking for improvement in these forecasts? There used to be some years ago?—There is frequently a complaint regarding the jute forecast.

A.3040. Do they think jute forecasts too optimistic or pessimistic?—Sometimes one way and sometimes the other. It is a forecast got out by the Director of Agriculture in Bengal direct. I do not know of any trade complaints regarding other forecasts.

A.3041. *Professor Gangulee:* The other forecasts are not made by the Department of Agriculture; only the jute forecast is made in that way?—That is so. The figures for other crops are supplied to us by the Provincial Departments and we compile them for all India.

A.3042. *Sir Henry Lawrence:* In every case the information comes from the Director of Agriculture, does it not?—In the case of tea, coffee and rubber it comes direct from the gardens. The figures for all the major crops we get from the Agricultural Departments.

A.3043. *Sir James MacKenna:* Except rice in Burma, which you get from the Commissioner of Settlements?—Yes.

A.3044. *Sir Henry Lawrence:* What are your relations with the Indian Trade Commissioner in London? Have you any particular liaison with that officer?—We try to put people in India in touch with purchasers in other countries, and if these countries happen to be in Europe, we generally do it through the Indian Trade Commissioner in London, because he has more extensive information regarding the standing of firms in Europe than we have. In other parts of the world we work through the Department of Overseas Trade representatives; in Canada and South Africa, for instance.

A.3045. You are in communication with officers belonging to the Department of Overseas Trade?—Yes, in all countries where there are such officers. When there is a reference to any European country, however, we generally work through the Indian Trade Commissioner.

A.3046. Has the Indian Trade Commissioner got his office along with the High Commissioner?—He has his office in the High Commissioner's office in Grosvenor Gardens. He had at one time an office in the City, but that was given up owing to retrenchment. He now has a room in the City to which he goes two or three times a week to interview business men.

A.3047. In your opinion is the present situation of his office near Victoria Station, a convenient one for the promotion of trade in London?—The situation of his office may be bad, but the system of having an Indian Trade Commissioner in London is good.

A.3048. Do you think he is sufficiently in touch with the City?—I think, as a matter of fact, the Indian Trade Commissioner at present is in very close touch with the City. There is now a proposal to have another office in a more convenient spot. That proposal is before the Government of India, and I think it has been accepted at any rate by the Standing Finance Committee.

A.3049. The expenditure will be on this budget?—I believe so.

A.3050. *Sir James MacKenna:* With 8 lakhs as a first contribution?—Yes. That will certainly bring his office into closer touch with the people in the City, but at present he is personally in very close touch (and has been for a long time) not only with business people in London but in Manchester and other parts of the United Kingdom.

A.3051. *Sir Henry Lawrence:* Does that officer concern himself with the questions affecting the purity or grading of exports from India?—He writes frequently about these questions and we try to get the people out here to do something, but actually he cannot do very much if the trade does not move in the matter.

A.3052. Have you heard complaints of the impurities in wheat and oil-seeds?—Yes, both in wheat and oil-seeds we have had complaints; the Indian Trade Commissioner writes out here, tells us what the complaint is. We go to the exporters; they generally know a fair amount about the complaint before we hear about it; we ask them what they can do and that is about where it ends.

A.3053. You ask them to do something about it?—Yes, ask them if they could improve the quality.

A.3054. Is there any action that they wish Government to take that is feasible? Have the exporters from India made any suggestions to you that Government should take action?—No, they have never put forward any suggestions so far as I know; I understand there is a clause in the wheat contract which limits the percentage of dirt to a certain figure; I do not know whether that is still in force or not.

A.3055. Do these questions of grading come strictly within the functions of your office?—No, it does not really come within our duties, but if we feel we can do anything, we make an effort unofficially; we simply try to do the best we can by visiting the exporter and explaining to him what the complaint is.

A.3056. Have you any suggestion to make as to any action that could be taken by Government to meet these complaints?—I have not actually thought of any action, but you must be aware of the fact that Government has established a Grading Board for the export of coal; it might be possible to establish a Grading Board for the export of other materials as well as coal. The Grading Board for coal gives a certificate of the quality of the coal exported.

A.3057. Is there any such machinery in being in any other country that you know of?—I believe there is some such machinery in Canada with regard to the export of wheat, but I do not know any of the details; that is with regard to the pooling of wheat.

A.3058. That is connected with the elevator system, is it?—Yes, but I do not know the details.

A.3059. A specific case with regard to ground-nuts was mentioned to this Commission recently in regard to the method of decortication, the ground-nuts being wetted. Have you had occasion to enquire into that at all?—I have not had any occasion to enquire into it, but I think I know about it; I think they wet the ground-nuts when they are decorticating them, and they are rather inclined to ferment. It has not been brought to our notice.

A.3060. Who should move in such a matter? Should the initial impetus come from the Chambers of Commerce?—In all these cases we like the impetus to come from the trade itself, because if a Government officer interferes in any way, it does not help much; if the impetus were to come from the trade probably something could be done.

A.3061. But so far no Chamber has moved in this matter?—In that particular matter I should not think so.

A.3062. If they did move, in what form or shape would it be? By representation to the Department of Commerce and Industry? Would that come to you in the ordinary course?—It would probably come to the Government of India first of all and then be sent to me to enquire into it and report.

A.3063. So far that has not been done?—No.

A.3064. Then, with regard to the general aspect of your work of commercial intelligence, is there any particular action or policy that you wish to suggest that requires further investigation?—I have made suggestions to other Commissions and Committees; for instance, to the Textile Committee I suggested that it would be advisable to have representatives in, say, South Africa, East Africa and Mesopotamia with a view to extending export trade with those countries, but I have not put forward that proposal to this Commission.

A.3065. Do you regard that as a matter of some importance?—Yes, to have overseas representatives, in fact, Indian Trade Commissioners, in other countries besides the United Kingdom. It is not a new proposal, it has been before the Government of India before; it was discussed in 1919 and 1922 and the department had a representative in East Africa for about a year, an Indian Trade Commissioner, with a view to finding markets for Indian exports overseas.

A.3066. Have you got any Indian officers of good status who are being trained in this work of commercial intelligence in your office?—We have only one Indian officer and he is fairly advanced in years now; we have no others coming on being trained.

A.3067. If you had such Indian Trade Commissioners in those countries would you be able to find suitable officers to fill the posts?—I think it would be possible to find suitable officers.

A.3068. Indians?—I think they would almost certainly be Indians.

A.3069. Would they not require any special training?—They would probably have to spend some time in the department before going overseas.

A.3070. At present there is no machinery for that?—We have no machinery at present for training them as so far there have been none.

A.3071. *Sir James MacKenna:* On page 365 of your note you refer to an export cess on hides and skins. I take it that so far from desiring its abolition, you suggest that it might be increased?—At present there is an export duty of 5 per cent on hides and skins; there is a feeling that that export duty might be removed sometime in the future.

A.3072. I suppose you are aware that there is a very strong feeling against it, except in Madras and Cawnpore?—There is a very strong feeling against the export cess, and I believe the general idea is that it will be removed. This proposed cess is supposed to be a relief, a very small thing; if the 5 per cent was removed this might be only a half or a quarter per cent; it would be a nominal export cess after the 5 per cent has been removed.

A.3073. What did Burma say about that?—I have not been to Burma yet; I have not discussed it with them. I discussed it with the Calcutta Hides and Skins Shippers' Association last Friday. This cess would not bring in very much revenue. I have not worked it out, but could easily do so.

A.3074. Even under the existing 5 per cent I do not think the revenue is a great sum; it causes a great deal more irritation than financial result?—If we got the total figures of export of hides and skins, we could easily work out how much revenue it would yield.

A.3075. Are you generally in favour of export cesses?—No, generally I am opposed to export cesses.

A.3076. Do you think export cesses would be more justifiable if a portion of the resulting revenue were to go to specific researches on particular crops?—Yes, I think that is the only way in which these export duties can be justified; that is to say, that the revenue returns are to be spent on the actual trade as is done with regard to tea, lac and cotton. The jute cess is not used in that way.

A.3077. Do you consider the Agricultural Department is the suitable agency for framing crop forecasts, or can you suggest any other department of Government that has better material available for the purpose?—I cannot think of any other department that would have any better material than the Agricultural Department; the difficulty with regard to these forecasts is that the material is perhaps not as good as it might be.

A.3078. The point is that the Agricultural Department has not any particular interest in the area, which is of equal, if not greater, importance than the outturn?—Of the three factors area is the big one and area seems to be fairly accurate.

A.3079. That is from the land record side?—Yes. Then there are these two other factors: the standard yield and the condition. The condition is generally expressed in so many annas: a sixteenth; if it is wrong by one anna you have 6¼ per cent error straightway; whereas the area is not likely to be wrong to the same extent.

A.3080. So that for determining the outturn, which is of course a basic factor, you think the Agricultural Department is in the best position?—I think so.

A.3081. Have you had any representations from the Agricultural Department about the excess of work which it throws on their staff or the inadequacy of their staff for the purpose?—No, I have not had any representation.

A.3082. Are you in favour of a separate statistical branch in each Province to deal with crop forecasts and other statistics?—A branch of the Agricultural Department?

A.3083. Yes, giving them more staff?—Yes, certainly I am in favour of giving them more assistance if they need it.

A.3084. I think you are an *ex-officio* member of the Central Cotton Committee?—Yes.

A.3085. What is your view of the work of that body?—I have been in that position only for the past 10 months and have had the opportunity of attending only one of the meetings.

A.3086. How does it strike you? Does it strike you as being a body getting down to the problems of cotton research and development?—I do not know that I could express an opinion that would be of much value having attended only one meeting.

A.3087. Have you any indication in your office that they are taking any keen interest on the statistical side of the work?—Yes.

A.3088. You have regular returns of the amount of cotton pressed issued by your office?—Yes; we issue them weekly.

A.3089. Is that of any assistance to the trade?—The trade is very anxious to have it; so far as I can judge it has been of great assistance to them.

A.3090. Do the Indian States take any interest in them?—Yes, to a certain extent, but not to the extent that we should like.

A.3091. Are the main cotton growing States coming in?—Yes, they are gradually coming in.

A.3092. There is the Cotton Ginning and Pressing Factories Act. Do you think that it is of any material assistance to the cotton industry?—The manufacturers are very keen about those statistics; they are anxious to have them as rapidly as possible, so they must be of assistance.

A.3093. Are these returns the result of the operations of the Indian Cotton Committee of 1917?—I should think so, but I have not studied the point.

A.3094. *Professor Gangulee:* With regard to the research work which you have mentioned, would you have the Government of India set up an agency for co-ordinating the activities of the provincial research organisations, or would you have them carry out research in their own organisation?—I would place the research work under the Government of India and the organisation would be the Government of India organisation.

A.3095. The research should be done entirely by the Government of India and their staff?—Yes in different localities. For instance the research work referring to jute you would have in Eastern Bengal, but it would be under the Government of India and not the Local Government.

A.3096. Research work in cotton to be in cotton areas, research work in rice to be in Madras or Burma and so on; is that your idea?—Yes.

A.3097. You would not entrust the Provincial Government with any research work at all?—I think it would be more economical to keep the research work under one body, the Government of India. We started a little research in tannery in Calcutta and it is believed to have done good work. Then the other people throughout India all began to think that research is a good idea and the tendency is to start research tanneries all over the place, whereas one research tannery running well and doing good work can produce good results for wide areas.

A.3098. Your idea is that the fundamental researches should be carried out by the Central Government and they would transmit any information they get to the Provincial Departments and the Provincial Departments would test the results in their experimental farms?—Yes. The Government of India could certainly depute the officer who had done the research work and had arrived at his conclusions to instruct the Local Government officers.

A.3099. So you would have the Provincial Departments of Agriculture simply to do demonstration?—Demonstration and propaganda.

A.3100. No experiments?—The experiments would be done by the Government of India in the local areas.

A.3101. *Sir Henry Lawrence:* Do you anticipate any friction between the Imperial and the Provincial Governments in regard to the distribution of functions and things like that?—I do not think the idea would be popular with the Local Governments, the idea of separating the functions; but I suggest this as a method of co-ordinating the work and to save overlapping and from the point of view of economy and also to give men who are doing research work freedom and liberty to go on with research work without having their time occupied in demonstration and propaganda work.

A.3102. *Professor Gangulee:* I find from your note that the tea cess is utilised for research work in connection with tea and the same is the case in regard to lac and cotton; but in regard to the jute cess the amount collected is given to the Calcutta Improvement Trust and nothing is spent on jute experiments and jute research?—I do not think the whole of it is paid to the Calcutta Improvement Trust.

A.3103. A portion of it goes to the Government of India?—I have not got the Act with me, but I think 2 annas in the rupee, or something like that, goes to the Improvement Trust.

A.3104. A portion of it goes to the Improvement Trust and another portion to the Central Government, and none for research in jute?—Except that the portion going to the Central Government goes to the general revenues.

A.3105. But it is not earmarked for jute research?—No.

A.3106. Do you think that the earmarking of particular revenue for a particular purpose is a sound financial policy?—I think it has been fairly successful in certain directions. The Indian Tea Cess Act has been fairly successful. There of course you have very highly organised industry, capable more or less of control.

A.3107. You make a reference to roads. Are you aware of this idea of a Central Road Board?—Yes.

A.3108. What is your view on that?—I have simply indicated that I think if it were possible to have local roads running out from different railway lines as feeders to the railways it might be more economical so far as transport is concerned.

A.3109. What would be the relation of the Central Board to the Provincial Road Board?—I have not thought it out at all.

A.3110. With regard to fertilisers and other things you say that Agricultural Departments of the Local Governments should be used as agents for distribution. Would you not like to have business men or private enterprise undertaking that?—First of all to make the fertilisers popular I would introduce them through the Agricultural Departments. As I have said I would even go so far as to distribute free samples of fertilisers.

A.3111. *Sir Henry Lawrence:* At the expense of public revenues?—Yes.

A.3112. *Professor Gangulee:* You would have the Government to distribute the fertilisers and you suggest that implements also should be given on the hire purchase system by the Government to the cultivators; you eliminate private enterprise altogether from this sort of work?—Private enterprise at present cannot do it because the whole thing is so scattered.

A.3113. In introducing artificial fertilisers do you not think that Messrs. Shaw Wallace & Co. did more than the Departments of Agriculture? This year the British Sulphate of Ammonia Federation in London have earmarked £20,000 for propaganda work in India. Do you not think it advisable for the Provincial Departments of Agriculture to co-operate with the trading agencies?—I think I have indicated that this business of giving out samples is merely to popularise it and more or less as propaganda work. I do not want to turn the Agricultural Department into companies for selling fertilisers.

A.3114. Turning to the question of statistics, what is the basis of calculating standard outturn per acre?—It is done by the Agricultural Department.

A.3115. Through their crop cutting experiments?—Yes.

A.3116. Would you tell us how these experiments are conducted and by whom?—I do not know.

A.3117. Are they conducted on any one definite area or at random?—I do not know.

A.3118. What is the system adopted in the Punjab for the purpose of crop cutting experiments?—I do not know.

A.3119. Have you considered the possibility of aeroplane photography for reporting crop condition?—No, I have not thought of it.

A.3120. That is being tried in America and also in England?—I have not thought about it.

A.3121. You have, in the ryotwari tracts, your subordinate revenue agency and you find it convenient to collect agricultural statistics in those areas, but you find it difficult to get them in permanently settled areas?—Yes.

A.3122. Have you got any suggestions to make as to how that difficulty could be overcome?—No, I have no suggestions to make.

A.3123. I find that in your 'Agricultural Statistics' you do not give the value of produce; you give only the total amount of it. Do you think it is advisable to give the value of production based on the harvest prices?—I suppose it could be done as harvest prices are given.

A.3124. My general impression is that there is no uniformity in the method of collecting the statistics throughout India; they vary from Province to Province, do they not?—Yes, in details but uniformity exists in the general principles.

A.3125. Do you think some sort of uniformity would be advisable, some standard method?—Of course it would mean increase in staff in department which collect the materials.

A.3126. *Mr. Calvert:* What is the present position in regard to the revival of the rail-borne statistics?—The file came to me only the other day and I am taking up the question. May I say that we started collecting certain figures for cotton and we are getting returns from Railways with regard to the movements of cotton from one block to another. That is the first step and it is costing us about Rs. 10,000 a year. The revival of rail-borne statistics is a matter of money and Local Governments have stopped collecting those statistics and they will not probably be very willing to start them again. The subject however is before the Government of India and the idea is to revive them.

A.3127. Are there any Local Governments who have already agreed to revive them?—The Central Provinces Government has continued collecting them all along; I do not know about the other Governments having agreed.

A.3128. Do you think there is really much advantage in collecting totals for all India? Are not the totals of different things misleading? Take the case of bulls: sometimes you would show about one bull to 500 cows; and in the next quinquennial return you would show perhaps one bull to 50 cows. The meaning of the word bull would vary enormously according to your statistics?—These are figures which are collected by Local Governments and sent to us and we put them together; that is all we do really.

A.3129. Do you think that the totals are worth publishing? The totals of two quite different things would be misleading; for instance, a pair of bullocks in the Punjab can plough 14 acres; in Bengal we were told they can plough only about 3 acres?—It is really the total of the animals and not the total of the motive power that is shown.

A.3130. Do you think your estimates of yields are of any value?—I suppose they have some value.

A.3131. The ordinary commercial people in the Punjab add 30 per cent of the official estimate. Is that the correct thing to do?—That is their method and if by adding 30 per cent they are sure of obtaining the correct figures the statistics surely have some value.

A.3132. Did you ever hear of a challenge given to expert agriculturists that not one of them could estimate a crop within 25 per cent?—No.

A.3133. Can you suggest any way of avoiding the human element in these outturn estimates?—The only thing I would suggest would be to go on with the crop cutting experiments.

A.3134. But, as long as your cutter selects the field, he takes what he thinks is the average or the normal and then he says that that is the average or normal; that is to say he first gets the answer and then produces the method of arriving at it? Is there any method in other countries where the human element is eliminated?—If we could get the final figures of the actual production we might be able to do something.

A.3135. But that is not possible?—No.

A.3136. In the United Provinces land is about half the value of what it is in the Punjab but their estimated outturns are 50 per cent higher than ours. That suggests that the outturn figures are worthless. Have you ever enquired into that at all?—No, but we know that that is the factor in the statistics which is least satisfactory.

A.3137. *Mr. Kamat:* In this estimate of outturns you take your figures from the Agricultural Departments and they in their turn depend on the revenue agency. Is it possible to make the Agricultural Departments self-sufficient in this respect, without depending on the Revenue Departments?—If you make them self-sufficient you simply increase the number of the staff required, and incidentally the expenditure would also increase.

A.3138. I am told that in the Madras Presidency there is a statistical branch under the Department of Agriculture who do the statistical work; is that true?—I cannot say.

A.3139. You say on the question of staff that it would entail a very heavy expenditure if to the Agricultural Department is attached a statistical department of its own?—If they are going to collect original materials then it will mean a large expenditure, but if they are simply going to put together in the head office the materials which they get from other sources, then it would not mean a very large expenditure. But if you are going to change the staff that collects the materials, then you are going to duplicate it practically.

A.3140. With regard to this question of a cess on exports, when you collect the cess, for instance, on tea, jute or cotton, and when you hand over, after deducting the expenditure, the amount collected to the different committees such as the Cotton or Tea Committees, do you impose any conditions on them? Have they to submit to you the annual accounts showing how they spend the money?—I think that the accounts have to be published and audited in the usual way as far as I remember.

A.3141. Is there any control which accompanies the payment of these collections to these different committees?—Not that I know of. In the case of the Indian Association Committee I do not think there is any control; I think the money is handed over to them to use it to the best advantage.

A.3142. They have the fullest discretion to use the money to the best advantage?—Yes.

A.3143. You said you were against the idea generally of an export cess. Is your objection simply because of this *ad hoc* taxation principle, or earmarking principle?—No, I said I was against the principle of the export duties.

A.3144. If that money could be used for the development of agriculture, would you still be against it?—Not if it goes back into the industry from which it was taken.

A.3145. Would you not be none the less against the thing on principle?—No.

A.3146. And you would also not impose any control on the part of the Government of India if the money were to be utilised by the Local Governments at their best discretion for agriculture?—I suggested that they should use it for research in agriculture and I also suggested elsewhere that the research should be under the Government of India.

A.3147. You said in the case of tea or cotton organisations there was no control, to your knowledge?—Not so far as I know.

A.3148. Would you extend the same principle if a fund collected, say, for agricultural purposes were handed over to Local Governments without control?—If there was a chance of its being utilised as successfully as in the case of the tea cess, then I think I would agree.

A.3149. If the Government of India do not insist on control in the one case, surely they can carry out the same principle in the other case?—The Indian tea industry is very highly organised and highly controlled.

A.3150. But if you can trust the Indian tea organisation, I think surely you can equally well trust the Local Governments?—Yes.

A.3151. *Sir Thomas Middleton:* You pointed to the case of your tannery in Calcutta as an illustration of the benefit of centralised research. Does it not occur to you that much of the work with which Agricultural Departments are concerned is so conditioned by local factors that a centralised institution might not in their case be as suitable as in the case of your tannery?—I think I tried to indicate to Professor Gangulee that the research work would be done under local conditions although it might be directly under the control of the Government of India.

A.3152. That would take the responsibility for research entirely out of the hands of the Provincial Departments of Agriculture?—Yes.

A.3153. You have already indicated that you are aware of the very strong feeling which would be created if any such attempt were made?—Yes, I think so; but at the same time I still think that greater progress will be made in research if the energies of the men who are doing research work are co-ordinated. The difficulty about research work in this country is the lack of atmosphere.

A.3154. And the lack of men?—The lack of men first of all, and also the lack of a scientific atmosphere. It is very difficult for a man in the Province to carry on research work simultaneously with his ordinary office work. There cannot be any continuity when he has to look after both jobs. I think myself that more progress would be made if the men who are doing research work could be kept on that work for a longer period of time and could be given facilities for meeting other men who are doing research work in order to discuss and exchange views on their problems and their difficulties.

A.3155. While the work of a Director of Agriculture is mainly administrative, he is a man who has presumably lived in the Province for, let us say, 20 years and during this long period he has been up against the difficulties which crop up in a Province. Do you not think that his views in connection with what is required to be done would be most valuable in formulating the lines of research?—These lines of research could probably be laid down by some central body such as you have in existence at present in the shape of periodic conferences which should meet at short intervals. At present these conferences take place at intervals of about two years, and I would suggest that they should meet at shorter intervals.

A.3156. You referred to the possibility of distributing free samples of fertilisers. I think your idea was that these free samples should take the form of small quantities to show how they were to be used in field work?—The fields in which definite types of fertilisers had been used should be indicated.

A.3157. And the work would be definitely experimental in character?—Yes.

A.3158. And the total quantity required for the Province would be quite small?—I had no intention of distributing fertilisers free to the whole Province; it would be quite a small thing.

A.3159. You are possibly aware of the fact that the practice is commonly followed in Great Britain?—Yes.

A.3160. Your own functions with regard to statistics are purely editorial? —Yes, practically compiling and publishing these agricultural statistics. But we examine and scrutinise the statistics before compilation and point out to local authorities any errors or discrepancies that may be found out, for explanation or correction.

A.3161. Reference has already been made to the errors which occur and the difficulties which arise in certain Provinces. Have you at stated intervals conferences of all those concerned in supplying you with agricultural statistics?—Yes, there have been such conferences in the past. I took over this work only ten months ago, and I have not attended any such conferences, but I know from the records they have been held in the past.

A.3162. The difficulties and errors which may occur in connection with statistics in certain Provinces have presumably been discussed at these conferences?—I expect so.

A.3163. You say that generally speaking you are satisfied with the area figures?—Yes.

A.3164. I have heard it said that there is considerable doubt as to whether the figures of the professional surveys are accurate. They correspond very closely with the figures taken from village papers; indeed, for All-India the correspondence is suspiciously close. Do you think there are compensating errors in both which may account for the correspondence?—Possibly.

A.3165. You have indicated that in one Province in particular the figures were doubtful. Are there not others where they are almost equally so? In the case of which Provinces do you think the figures are based largely on estimates?—Bengal, Bihar and Orissa, parts of Madras and Assam.

A.3166. The others are reasonably accurate?—Yes.

Except that Mr. Calvert has told us that in the Punjab the official estimates of outturn must be a long way out.

Mr. Calvert: They are everywhere.

A.3167. *Sir Thomas Middleton:* You have told us you are not aware of the number of crop experiments now being made?—No. (See provincial reports of crop cutting experiments.)

A.3168. These crop experiments have in certain Provinces been conducted very extensively and for a long time. Do you know whether there is any sort of uniformity amongst Provinces as to the number of crop experiments? —I have no figures on which to base an answer to that question (there appears to be no uniformity).

A.3169. Would it not be desirable to arrange some uniformity of system in crop experiments?—Yes.

A.3170. *Sir Henry Lawrence:* You have referred to export cesses in your note. In addition to these there are export duties, for instance on jute. Do you consider there is a case for demanding the expenditure of a portion of the money so obtained in research which will benefit the particular crop on which a duty is levied?—That would mean earmarking portions of duties. At present they go to general revenues and reseach work is financed from general revenues.

A.3171. On what items are there export duties?—Jute, rice, hides and skins and tea.

A.3172. Is there a duty as well as a cess on tea?—Yes.

A.3173. It has been represented with regard to certain industries that since they are paying specifically to Imperial revenues something ought to be done for them from those revenues in the way of research. Do you think that is sound?—Yes.

A.3174. Can you give us any general figures showing the percentage of export trade to internal outturn?—I have not worked out any figure for that, but I believe a figure of 10 to 1 was worked out at one time, *i.e.*, 10 times as much was consumed in the country as exported. I will try to work out as accurate a figure as possible and let you have it.*

A.3175. It has been suggested to us, with regard to the staff engaged in research at Pusa, that it would be better if that staff were interchangeable with the Provinces. I take it you are opposed to that view?—I should be in favour of allowing these men to be deputed to the Provinces. I think the idea was that they should be brought in touch with day-to-day problems of administration and not confined solely to research.

A.3176. You would prefer them to be engaged solely on research from start to finish?—Yes, but I should expect them to keep in touch with the problems on which they were doing research.

A.3177. *Mr. Calvert:* Did you see the report of the committee appointed by the Punjab Government under my chairmanship to inquire into methods for improving agricultural statistics?—No.

A.3178. You were not consulted about that?—No.

A.3179. *Professor Gangulee:* Do you think trading circles in Great Britain interested in agricultural produce get adequate information from your department?—We send a weekly cable to the Indian Trade Commissioner, and he publishes it or rather we send it to Reuters, who publish it. It is also published in the Board of Trade Journal. The cable is a summary of information supplied to us regarding weather and crop conditions.

A.3180. You think you are giving enough publicity to Indian agricultural produce in England?—If we are asked for more information we give it. When there are any questions they come to the Indian Trade Commissioner in London, and he seems to be satisfied with what we send.

A.3181. *Sir Thomas Middleton:* Do you call the 16-anna crop the normal or the optimum crop?—We take 100 as the normal.

A.3182. What is 100 converted into annas?—We still get figures from the Provinces in annas, and we have for each Province what we consider to be their normal, which may be 12 annas for one Province, 10 for another and so on.

A.3183. Could you let us have a list of the normals for the different Provinces?—I shall send that to you.†

(The witness withdrew.)

For the evidence of other witnesses examined at Delhi, see the Volumes of Evidence for the United Provinces and the Punjab.

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* Reference may be made to Table No. 44 of the *Review of Trade* for 1925-26, showing the proportion of exports to total outturn in the case of certain principal crops for which complete figures of production are available. It would not be unreasonable to estimate that in normal years about 10 per cent of the total outturn of food grains is exported from India. Regarding oil-seeds, the exports in an average year may be put at about one-third of the total production. In the case of cotton and jute the internal consumption is much below the production and about 50 per cent of the total output is normally exported. Tea and coffee are principally grown for export abroad.

† *Vide* Appendix.

APPENDIX.

Statement showing the number of annas by which a normal crop is indicated in the various Provinces.

Madras	12 annas.
Bombay	
Bengal	
Assam	
Bihar and Orissa	12 to 14 annas.*
Central Provinces and Berar	13·3 annas.
†Burma	16 annas.
United Provinces	
Punjab	
N. W. F. Province	
Delhi	
Ajmer-Merwara	
Coorg	

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* 12 annas in twelve districts, 13 annas in seven districts and 14 annas in two districts.

† Anna notation no longer used, American notation being used.

Dr. D. B. Meek.

MGIPC—L—476RC on A—2-7-27—2,002.

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GLOSSARY.

ANNA	One-sixteenth of a rupee; equivalent to 1⅛d. at exchange rate of one and sixpence to the rupee.
ARHAR	Pigeon pea (*cajanus indicus*).
ATTA	Wheat flour.
BABUL	A widely distributed small tree (*acacia arabica*).
BAJRA	A small millet (*pennisetum typhoideum*).
BANIA	A Hindu trader who is generally also a moneylender.
BARANI	Unirrigated land depending on rain for its water supply
BERIBERI	A dangerous deficiency disease endemic in parts of India and Ceylon.
BERSEEM	Egyptian clover (*trifolium alexandrinum*).
CASTOR	*Ricinus communis.*
CHAPATTI	A thin unleavened cake of flour and water, slightly baked over an open fire.
CHOLAM	The Tamil name for the large millet (*sorghum vulgare*).
CHULHA	A fireplace.
CRORE	Ten millions.
CUMBU	See *Kambu.*
DAL	A generic term applied to various pulses.
DESHI	Native to the country, indigenous.
DHUB	Couch grass (*cynodon dactylon*).
GHAT	A mountain; a landing place on the bank of a river.
GHI	Clarified butter.
GOGU	A fibre plant (*hibiscus cannabinus*).
GOLA	A storeroom.
GRAM	Chick-pea (*cicer arietinum*).
GUINEA GRASS	*Panicum jumentorum.*
GUR	Unrefined Indian sugar, jaggery.
JAMADAR (JEMADAR)	A supervisor.
JUAR (JOWAR)	The large millet (*sorghum vulgare*).
JUNGLI	Wild, waste, savage; belonging to the forest.
KALA-AZAR	A chronic fever of North East India with greatly enlarged spleen; resistant to quinine.
KALAR	Saline efflorescence.
KAMBU	A small millet (*pennisetum typhoideum*).
KANS	A coarse deep-rooted grass weed (*saccharum spontaneum*).
KHARIF	The autumn harvest: crops sown at the beginning of the rains and reaped in October–December.
KODRA	A small millet (*paspalum scorbiculatum*).
KURBI	Straw of juar (millet).
KUTCHA	Inferior or bad [literally, " not solid "].
LAKH	One hundred thousand.
MAHAJAN	Merchant, moneylender.
MALIK	Owner, proprietor.
MANGO	An evergreen fruit tree (*mangifera indica*).
MARWARI	A banker, broker, merchant.
MAUND	A weight of 82·28 lb. (*pucca maund*). Has different values for different commodities, and for the same commodity in different localities.

Paddy	Rice (*oryza sativa*).
Palas	A moderate sized deciduous tree (*butea frondosa*).
Panchayat	Lit., a committee of five. Used to describe an association of any number of persons, instituted for objects of an administrative or judicial nature.
Patwari	A village accountant or registrar.
Pucca	Of good quality, up to standard, correct, substantial.
Purdah	A veil, screen; the practice of keeping women secluded.

Rab	The practice of burning leaves, grass, sticks, etc., on land as a preparation for sowing.
Rabari	A caste of herdsmen and milkmen.
Rabi	The spring harvest; crops sown in autumn and reaped at the end of the cold weather.
Raji (Ragi)	An inferior variety of millet (*eleusine coracana*).
Ryot	A cultivator.
Ryotwari	A system of tenure under which the cultivator pays the revenue direct to Government.

Sal	A large gregarious tree (*shorea robusta*).
Samba	A superior kind of rice.
Sawan	A millet (*panicum frumentaceum*).
Senji	A fodder crop (*melilotus parviflora*).
Sesamum	An oil seed (*til*) (*sesamum indicum*).
Shakkar	Sugar.
Sorghum	A genus of grasses, the most important of which is juar the great millet (*sorghum vulgare*).
Sowcar	A moneylender.

Taccavi	An advance made by Government to cultivators for agricultural purposes.
Tapidar	A subordinate revenue official.
Thana	A police station, a post.
Tonga	A horse or bullock carriage.

Zamindar	A landowner, a peasant proprietor.

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